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abama Agricultural Experiment Station



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DECEMBER, 1900.

ALABAMA

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,  
AUBURN.

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## ORCHARD NOTES.

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By

F. S. EARLE.

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MONTGOMERY, ALABAMA.  
THE BROWN PRINTING CO.  
1901.



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 The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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## ORCHARD NOTES.

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The season of 1900 has been on the whole a favorable one for the orchardist. At Auburn the earliest blooming plums and peaches were killed by a sharp freeze on Feb. 18, when the thermometer dropped to 12°. The latest blooming plums like Wayland and Golden Beauty were injured by continued cold rains during the last of March that prevented pollination, causing the first nearly complete failure of the crop on these kinds in five years. The medium blooming plums and peaches set heavy crops notwithstanding a cold snap on March 17, when the thermometer dropped to 28°. It was 30° the morning of the 16th and had dropped to 32° by 9 p. m., so that the open flowers were exposed to a freezing temperature for at least ten hours. Many blossoms were killed but as stated, enough survived to make a very full crop. Unusually rainy weather during June and July caused serious loss from brown rot in peaches and plums, the falling of grape foilage from the attacks of downy mildew, and a more than usually heavy loss from summer rot of apples.

### APPLES.

The condition of the new orchard (planted 1897-1900) continues to be very satisfactory. Our experience proves that it is entirely possible even on such thin drouthy land as ours to grow thoroughly thrifty, vigorous apple trees. Part of the land was seeded to hairy vetch in the Fall of 1898 and the remainder was seeded to vetch and oats in Oct., 1899. In March a strip three or four feet wide was plowed on each side of the row and was culti-



vated after every rain so as to keep a dust mulch about the trees. The middles were not plowed till the first of June in order to allow the vetch to ripen its seed so as to reseed the land. Frequent cultivations were continued till the middle of July when peas were broadcasted and cultivated in. The peas made a good growth during the late Summer and Fall and have been allowed to lie and rot on the ground. As the peas begun to die down the self-sown vetch seed began coming up and by spring the orchard will be a solid vetch field. The same treatment will be continued another year, plowing strips next the trees in March, allowing the vetch to stand in the middle till the seed is ripe and then cultivating the entire land thoroughly till middle of July and again broadcasting to peas. By this method two crops of rich leguminous vegetable matter are added to the soil each year so that it is rapidly gaining in fertility. The mechanical condition is already greatly ameliorated. Last Spring each tree was given two pounds of fertilizer consisting of a mixture of five parts each of cotton seed meal and acid phosphate to one part of muriate of potash. The soil is now so much improved and the trees are growing so rapidly that no more fertilizer will be required until the orchard comes in to heavy bearing.

The bearing orchard received the same treatment as the growing orchard except that each tree was given ten pounds of the mixed fertilizer and it was sprayed twice with Bordeaux mixture, once on April 13 and again on April 28. At the last spraying one-half pound of Paris green per barrel was added to the Bordeaux mixture. At the time of the first spraying many of the trees were in full bloom and a number of the flowers were killed, showing that it is not advisable to spray during the blooming season. The first spraying should have been done earlier but pressure of other work prevented. The

treatment served to lessen the number of wormy apples very noticeably and it held the rot in check till about the first of July. After that owing to continued rains it developed rapidly and finally destroyed a large proportion of the crop on many of the trees. Two or three additional later sprayings would probably have partially prevented this trouble but it seems doubtful if, in unfavorable seasons like the present, it would have entirely prevented it. This rotting of the fruit on the trees before maturity seems to be the most serious problem that confronts the apple grower in this latitude. It will probably have to be met by more frequent sprayings than are necessary at the North, and especially by the selection of resistant varieties. Among the kinds fruiting at the Station this year, the following were comparatively free from rot: Carter's Blue, Horse, Pine Stump, Red June, Steven's Winter, Thornton's Seedling, and Terry's Winter. Those noted as rotting very badly were American Golden Russet, Ben Davis, Elgin Pippin, Golden Pippin, Kittageskee, Oconee Greening, Romanite, Shannon Pippin, Summer Red and Winesap.

*Apple Leaf Rust (Roestelia)*: Notes taken on Aug. 1, show the following varieties to be more or less effected by this disease.\*

Carter's Blue, slightly.  
 Chattahooche, slightly.  
 Cooper's Red, moderately.  
 Dam, slightly.  
 Equinettelee, slightly.  
 Ey. Red Marguerite, badly.  
 Family, very badly.  
 Hames, slightly.  
 Horse, moderately.  
 Jonathon, very badly.

\* For these notes and for other help in preparing this Bulletin, I am indebted to my assistant, Mr. C. F. Austin.

Mamma, slightly.  
 Red June, slightly.  
 Rhodes' Orange, slightly.  
 Rome Beauty, moderately.  
 Sabadka, slightly.  
 Santa, badly.  
 Senator, badly.  
 Shockley, moderately.  
 Texas Red, slightly.  
 Thornton's Seedling, slightly.  
 Wealthy, slightly.  
 Winesap, slightly.  
 Yavor, slightly.  
 Yopp' Favorite, slightly.

The following kinds were entirely free from rust: Aikin, American Summer, Apple of Commerce, Arkansas Black, Babbitt, Benoni, Ben Davis, Black Ben Davis, Bledsoe, Bradford, Buncomb, Champion, Carolina Greening, Cooper's Early, Duchess, Early Harvest, Elgin Pippin, Fall Pippin, Fanny, Grimes' Golden, Gravenstein, Hews' Crab, Jefferson Everbearing, Jennings, Julian, Kinnard's Choice, Limbertwig, Maiden's Blush, Mam. Black Twig, Mangum, Mavarack Sweet, Moultries, Oszi-vaj, Pear (or Palmer), Rawls' Janeton, Red Astrachan, Red Beitigheimer, Red Limbertwig, Saxon Priest, Sekula, Selymes, Shackleford, Summer Cheese, Summer King, Summer Queen, Sweet Bough, Taunton, Tuscaloosa, Yates, Yellow English, Yellow Horse, Yellow Transparent, York Imperial.

This agrees very well with last year's experience (See Bull. No. 106, p. 168) but American Summer and Moultries that showed rust last year escape, while fourteen kinds are affected this year that escaped last. A few of the Hungarian kinds are slightly affected this year for the first time, but in the main native American kinds

are more susceptible than foreign kinds. This is rather anomalous since the disease is indigenous, occurring freely on our wild crab apples.

*Green Aphis of the Apple*—In Bulletin No. 106 p. 166, it was noted that after being very abundant and troublesome the aphids suddenly disappeared during a period of heavy rains in August. The circumstances were such as to suggest that they had been carried off by some epidemic disease, but unfortunately no proof of this was secured. In any event the disappearance was so complete that in the Spring of 1900 the trees were almost clear of them and they have caused less damage than at any time in five years. Their numbers gradually increased so that by Fall they were again quite abundant but as the growing season was over they did comparatively little harm.

A new treatment was tried this season that proved much more satisfactory than the strong kerosene emulsion used last year, since it was equally effective in killing the insects and did no harm whatever to the foliage. Though home made decoctions of tobacco were unsatisfactory (See Bulletin 106, p. 164), the commercial product known as "Rose Leaf" proves to be by far the best insecticide yet tried for controlling this aphis. It is best used at a strength of one part to fourteen of water and should be applied as a very fine spray. Since it is impossible to reach all the lice at a single spraying on account of the shelter furnished by the crumpled leaves it is always best to spray two or three times at intervals of four or five days, since in that time those that escaped the first spraying will have moved out of their shelter seeking a fresher food supply. Three such sprayings within two weeks time should clear even badly infested

trees. Whether it will pay to go to this expense must be determined by the condition of the trees and the abundance of the lice.

It was hoped that spraying the trees with crude petroleum in winter might destroy the eggs of this insect. On March 12, a number of young trees that had been badly infested the year before were thoroughly sprayed with crude petroleum taking pains to direct the spray against the ends of the twigs where the eggs are usually deposited. The buds were still quite dormant. No injury resulted to the trees. The effect on the lice, if any, was obscured by the general scarcity of them during the early part of the season. By the first week in May a few lice could be found on each of these treated trees though none of them were badly infested. It was much later than this before they became numerous in any part of the orchard, so the treatment seems to have had no result so far as the aphids are concerned.

The question of varietal resistance to this pest is still an open one but as was noted last year, kinds with thick, hairy twigs seem to be less infested than those in which the young twigs are slender and comparatively smooth. Notes taken on Aug. 1, show the following kinds to have been more or less infested with aphids:

- Apple of Commerce, badly.
- Bledsoe, badly.
- Chattahooche, slightly.
- Jennings, badly.
- Mamma, moderately.
- Maverack Sweet, moderately.
- Oszi-vaj, moderately.
- Pear (or Palmer), moderately.
- Red Beitigheimer, moderately.
- Rhodes Orange, badly.
- Summer Queen, badly.
- Sweet Bough, moderately.
- Tuscaloosa, badly.
- Yellow English, badly.

By Nov. 10, the following additional kinds were more or less infested: Black Ben Davis, Bradford, Buncomb, Carolina Greening, Carter's Blue, Early Harvest, Equinettelee, Family, Fall Pippin, Gravenstein, Hominy, Jeffries, Limbertwig, Magnum, Mam. Back Twig, Moultries, Nickajack, Pasman, Rawl's Janeton, Santa, Senator, Shackelford, Shockley, Summer Cheese, Tull, Wine-sap, Yakor, Yates, Yopp's Favorite. Of these kinds 21 have smoothish twigs, 16 are medium, and 10 rather hairy. Of the kinds not infested with aphids, 8 have smoothish twigs, 18 medium and 28 hairy twigs.

This list does not coincide very closely with that given last year, showing that infestation or immunity is in part at least accidental.

*A List of Hardy varieties.*—The following kinds have been entirely free from rust, aphids and leaf spot and have made a perfectly satisfactory growth both in 1899 and 1900. Aiken, Babbitt, Hyari Piro, Magyur, Maiden's Blush, Metel, Ponyike and York Imperial. It is interesting to note that of these eight kinds four are among the new Hungarian varieties sent out by the Department of Agriculture that have not yet fruited in this country. Of the other kinds in last years' select list, Arkansas Black, Duchess, Fanny, Haywood, Milalyfi, and Thornton's Seedling lost some foliage from leaf spot late in the season, while Carolina Greening was slightly attacked by aphids, and Hames developed a little rust. Among the kinds not included in the above list that are in very satisfactory condition this Fall may be mentioned Battvani, Benoni, Bledsoe, Buda Summer, Carter's Blue, Champion, Elgin Pippin, Hames, Herschal, Cox, Horse, Julian, Keskemet, Kinnard's Choice, Limbertwig, Red Astrachan, Red June, Saxon Priest, Summer Wafer, Texas Red and Yellow Transparent.

*Promising New or Little Known Varieties.* For the

last three years an effort has been made to secure trees or grafting wood of all promising local seedlings in the hope of finding kinds better suited to our conditions than those now in general cultivation. A number of such kinds have been secured and the Station earnestly request all who are interested in apple growing in this State to co-operate by reporting any promising kinds that may come to their notice.

Among little known kinds deserving of special mention are the Hackworth and Herschal Cox. The Hackworth originated in North Alabama and has been grown there locally for twenty or thirty years. It is a vigorous, erect growing tree with large, healthy leaves. The fruit ripens in August. It is large subconic yellowish white, heavily striped with red. It seems to be free from rot and to be a very desirable late Summer apple. Herschal Cox is of the Romanite type, small and not of the best quality, but the latest keeper we have in North Alabama, surpassing even the Shockley in this respect. The tree is a better grower than Shockley and it should perhaps replace that variety for general planting.

*Revised List of Apples for General Planting in Alabama*:—The following list named in the order of ripening will give a good succession of fruit from the first of June till early winter. Yellow Transparent, Early Harvest, Red June, Red Astrachan, Horse, Hackworth, Carter's Blue, Thornton's Seedling, Kinnards Choice, York Imperial, Yates, Shockley, Herschal Cox. Unfortunately few, or perhaps none, of the above are fully satisfactory under our conditions and it is hoped that in the future better kinds may be substituted for them. Yellow Transparent is a poor grower and the foliage is somewhat subject to leaf spot. It is an abundant and early bearer and the handsome yellow fruit is free from scab and rot. For market it is the most promising of

the very early kinds. Early Harvest is rather better quality than the above and is nearly as early. It is to be preferred for home use. The tree is a fairly good grower but often suffers severely from aphids, and it is not free from leaf spot. Red June is a strong growing thrifty tree but unfortunately late in coming in to bearing and subject to rust. The fruit ripens through a long season and it is one of the most desirable for family use. On young trees and with good care and cultivation it is a fine market apple but with age and neglect it is too small for market. It should be in every family orchard. Red Astrachan is a vigorous, healthy, strong growing tree that comes early into bearing. The fruit is large and showy but too acid to suit most tastes, and is inclined to rot badly. Where this trouble can be controlled it is one of the most profitable of the early market apples. At Auburn it begins ripening about June 10 though some specimens can be gathered earlier. It does not all ripen at once like the Yellow Transparent but the trees need to be picked over several times. The Horse is a well known kind doing well in all parts of the South. The tree is healthy and a free grower. The large greenish yellow fruits are too sour for eating out of hand but are excellent for cooking. At Auburn it begins ripening early in July. The Hackworth has been mentioned on a previous page. It is unknown outside of Alabama, but seems very promising here. It ripens through a long season beginning the last of July and continuing throughout August. The tree is very thrifty and the large handsome fruits are of good quality and attractive. It is recommended for both home use and market. Carter's Blue is also an August apple, but averages a little later than Hackworth. It is a large green apple with dull red stripes and a heavy white bloom. It does not rot badly. The tree is healthy and a vigorous grower.



It is one of the few kinds that succeeds well at the far South. Thornton's Seedling is a good sized greenish apple with red stripes ripening in September. It is of good quality and its comparative immunity from rot marks it as valuable for an apple ripening at this season. The tree is healthy and productive. Kinnard's Choice has not been fruited at the Station but in North Alabama it is one of the most satisfactory kinds for late Fall and early Winter. The trees in the young orchard here are remarkably strong and healthy. York Imperial has also not been fruited here but it has made a good record in North Alabama and it is one of the few kinds in the young orchard that have been spotless and free from enemies of all kinds during the last two seasons. It is confidently expected that this will prove one of our very best late market apples. Yates is a favorite apple with many growers especially in Chambers, Tuscaloosa and Clay Counties. It is a good keeper and of the best quality but is too small for general market purposes. The tree is only a medium grower and is subject to leaf spot and to injury from green aphid. Shockley; this well known kind is valued chiefly for its keeping qualities. The apple is small and of rather poor quality and the tree is apt to be rather short lived. It is attacked badly by both rust and aphid and is only retained in the list for the want of something better that will keep as long. Herschal Cox is included here with some doubt. It is a better tree than Shockley but the fruit is about equally poor. However it keeps perfectly all winter in North Alabama which is a point of prime importance. It has not been fruited here.

It will be noted that Ben Davis Winesap and Limbertwig have been omitted from the above list although included in the list given in Bulletin 98, p. 265. It is

thought that Kinnard's Choice and York Imperial will fully take their places and be better suited to our conditions.

As a result of several years observation and study it seems prudent to strongly urge the increased planting of apples in Middle and Northern Alabama. It must be fully understood, however, that apples will succeed here only with the best and most intelligent care and cultivation.

### FIGS.

The following eleven kinds fruited on the Station grounds this season:

**Adriatic.** Large, yellowish white, flesh light red, late, beginning to ripen middle of August and continuing till frost; tree vigorous, fairly hardy, starting rather late in Spring. While not as sweet as Celeste it is pleasant in flavor and its large size makes it very attractive. It should be more widely planted.

**Black Ischia.** Large roundish, shinning black, flesh deep red, season last of August. Of no special value.

**Brown Turkey.** Small, light brownish, sweet, ripening during a long season. A fairly good fig but not equal to Celeste. With us the tree is feeble and a poor grower.

**Brunswick.** Large, pyriform, greenish yellow, nearly overspread with dark brown, flesh reddish brown, rich, season middle of August till frost, tree fairly vigorous and productive. With us this year the last of the crop did not ripen well. Not fully satisfactory.

**Celeste (or Celestial).** Small, pyriform, light brown, often with purplish tinge, flesh reddish, soft, very sweet, season July, tree thrifty, very hardy, starts early in Spring. This is by all odds our best early fig and the one in most general cultivation. On vigorous trees it

often sets a small late crop but these late fruits are inferior and many of them fail to ripen.

DuRoy. Small, much like an inferior Celeste. This much advertised kind has nothing to recommend it. Our trees were from Mr. Normand, the introducer.

Green Ischia. Medium size, rounded, yellowish green, skin thin, flesh deep rich red, sweet, high flavor, tree thrifty, fairly hardy, very productive, season last of August till frost. This is our best and most reliable late fig and should be widely planted. It does not begin ripening till the main crop of Celeste is entirely over.

Madeline. Large, light yellow, flesh yellowish white, rather soft, sweet, rich, season last of July and August, trees fairly vigorous and productive. This is a good fig and is valuable as ripening between Celeste and Green Ischia.

New French. Small, rounded, white, of medium quality, rather firm, tree a fairly good grower. It will take farther experience to decide whether or not this kind has any special merit.

White Nerii. Large, roundish, greenish yellow, flesh reddish, rather soft, good quality, begins ripening middle of August, tree feeble, not very productive.

White Smyrna. Medium and large, somewhat flattened, greenish white, overspread with a tinge of brown, flesh light red, firm, sweet, rich, season middle of August till frost, tree only moderate grower but fairly productive. This is a good fig and keeps remarkably well after picking.

*Recommended for General Planting:* Celeste, Green Ischia, Adriatic, White Smyrna and Madeline.

### KAKI (JAPANESE PERSIMMON).

As was noted in Bulletin 106, p. 171, the freeze of February, 1899, killed these trees all to the ground. Part were killed outright and part sprouted from the crown. The following kinds were sufficiently recovered to bear some fruits this season: Tabors No. 23, Tabors No. 72, Tabors No. 129, Tane Nashi, Yeddo Ichi.

This fruit is well adapted to the conditions in South Alabama and should be more generally planted in that region. The trees often begin bearing the year after they are planted and the crop is a very sure one. The fruits are large and handsome. Though too rich for some tastes most people are fond of them and they are gradually winning a place in the large markets.

### ORANGES.

Mr. H. J. Webber of the Department of Agriculture, Washington, has succeeded in making a number of hybrids between the cultivated sweet oranges and the hardy, deciduous hedge orange, *Citrus trifoliata*. His hope, of course, is to find among them some kinds that will combine the hardness of the one parent with the desirable fruit of the other. As these interesting productions have not yet reached bearing age it is impossible to foretell the result. Wishing to test their hardiness in this latitude the Department sent trees of fifty-one of these hybrids to this Station last Spring. They have nearly all made a very vigorous growth during the Summer but at this writing (Jan. 3) there has been no cold sufficient to test their hardiness. It is interesting to note that of these kinds three have died, thirty have small trifoliate, deciduous leaves like the hedge orange, only nine have large simple, evergreen leaves like the

sweet oranges, while nine have larger, variously modified trifoliate leaves that are evergreen. Their continued behavior will be watched with great interest.

### PEACHES.

The co-operative experiment orchard planted in 1898 bloomed abundantly but for some reason set a very light crop. The few older trees planted in 1896 bore heavily but the fruit rotted very badly on account of continued wet weather during the ripening season. Owing to the exceptional character of the season, it is thought best not to express an opinion as to the merits of the different varieties at this time. Notes on the season of blooming are given below. This subject is not as important with peaches as it is with plums as all the varieties are supposed to be self-fertile, but since a difference of even a very few days in the blooming period may decide the safety or loss of the crop from cold it is a matter worthy of consideration.

*Notes on the blooming of peaches in 1900.*

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17. Thermometer 28°.	March 25.
Matthews' Beauty.			buds pink.....	first blooms....	.....	full bloom .....
McKinney .....			nearly dormant.	buds pink .....	.....	first bloom.....
Marks.....			nearly dormant.	buds pink.....	.....	full bloom.....
Ovido .....			nearly full bloom .....	full bloom and falling.....	.....	mostly fallen.
Gray .....		first blooms. ...			.....	past full bloom.
Reeves .....			buds pink.....	first blooms ..	.....	full bloom.....
Carmen .....			buds swollen.	first blooms ..	.....	full bloom.....
Chinese Cling			buds swollen.	first blooms ..	.....	full bloom.....
Elberta. ....	Buds of all varieties slightly swollen except as noted below.		buds swollen, some pink.....	first blooms ..	Over half the open flowers killed except as noted. When petals have fallen they are killed as badly as the freshly open flowers. No unopened buds killed. No striking difference in the differ- ent varieties or races.	past full bloom.
Mamie Ross.....			buds pink .....	first blooms ..	.....	full bloom.....
Pallas .....			buds pink.....	first blooms ..	.....	full bloom.....
Tabor .....			buds pink.....	blooming.....	.....	full bloom.....
Honey .....	much swollen, not show'g pink	first blooms.....	nearly full bloom .....	full bloom.....	.....	mostly fallen...

*Notes on the blooming of peaches in 1900.*

Varieties.	Feb. 18. Thermometer 12°.	March 6.	March 10.	March 14.	March 17.	March 25.
Peento.....	full bloom.....		leaves 1 in. long full bloom, ¼ crop left.			leaves half grown.....
Angel.....	first blooms.....	blooming.....	full bloom, nearly full crop.	bloom falling.		leaves half.....
Waldow.....	first blooms.....	blooming.....	buds swollen ..	bloom falling...		full bloom .. ..
Old Mixon Free ..			buds swollen...	first blooms ..		full bloom.....
Mt. Rose .....			nearly dormant	buds hardly pink .....		first blooms ..
Alexander.....			blooming.....	blooming.....		past full bloom
Onderdonk .....		first blooms.....	buds pink .....	first blooms.....		full bloom.....
Cobler's Indian .....			first blooms.....	full bloom.....		past full bloom.
Imperial .....			first blooms.....	blooming.....		full bloom.....
Victoria.....			buds swollen...	buds pink .....		nearly full bloom .....
Triumph.....			buds pink .....	first blooms.....		nearly full bloom.....
Sneed .....			swollen, some pink .....	first bloom.....	buds ½ open. flowers 50 % k'd	.....
Old Orchard— Lady Ingold.....						

*Notes on the blooming of peaches in 1900.*

Varieties.	Feb. 18, Thermometer 19°.	March 6.	March 10.	March 14.	March 17.	March 25.
Tillottson .....	.....	.....	swollen, some pink. ....	first blooms ..	buds $\frac{1}{4}$ open. flow's 10-20% k'd	.....
Early Crawford. ....	.....	.....	swollen, some pink. ....	first blooms buds hardly pink. ....	1% open, flow- ers half killed	.....
Hale's Early .....	.....	.....	buds swollen. swollen, some pink. ....	.....	none open-d. none killed..	.....
Mt. Rose.....	.....	.....	nearly dormant. ....	first blooms buds hardly pink. ....	buds $\frac{1}{4}$ open. flowers 40 % k'd	.....
Alexander. ....	.....	.....	swollen, some pink. ....	.....	none open, none killed	.....
Stump .....	.....	.....	swollen, some pink. ....	first blooms buds hardly pink. ....	very few open, 40-50 % killed..	.....
Elberta.....	.....	.....	swollen, some pink. ....	blooming.. ..	buds $\frac{1}{4}$ open. flow's 20-40% k'd	.....



Classified according to the season of blooming we have the following:

*Earliest Blooming*:—Peento, Angel, Waldow, all of the Peento type.

*Very Early Blooming*:—Ovido, Honey, Onderdonk, of the Honey and Spanish types.

*Early Blooming*:—Imperial, Victoria; Spanish type.

*Medium Blooming*:—Matthews Beauty, Gray, Reeves, Carmen, Chinese Cling, Elberta, Mamie Ross, Pallas, Tabor, Old Mixon Free, Mt. Rose, Coblers Indian, Sneed, Lady Ingold, Tillottson, Ey. Crawford, Stump; including all of the North China type, most of the Persian and representatives of the Spanish and Honey types..

*Late Blooming*:—McKinney, Marks, Triumph, all Persian.

*Very Late Blooming*:—Alexander, Hales Early, both Persian.

The varieties of the Peento race all bloom so early as to be practically worthless for planting in any part of this State. They are the best peaches for the orange belt but should not be planted much farther North. Some at least of the varieties of the Honey and Spanish types bloom late enough to be comparatively safe and there is no question but what in South Alabama the trees will be found thriftier and better adapted to the soil and climate than most varieties of the North China and Persian types. Unfortunately as yet we have no varieties among them fine enough to compete in market with Elbertas and Crawfords and none as early as Alexander. A race of peaches combining the thriftiness and fruitfulness of the Honey with the late blooming of Alexander and the fine market qualities of the Elberta would indeed be a boon to the Southern fruit grower. Such a combination of characters is not beyond possibility to the skillful plant breeder and our originators of

new varieties should set themselves the task of producing it.

### PEARS.

Kieffer pears in the old orchard bore a heavy crop, while the LeContes made less than half a crop. Only a portion of the trees in the new orchard fruited.

In Bull. 106, p. 173, it was noted that one result of the February freeze (1899), which killed all the bloom buds was almost complete immunity from blight during that season. This immunity was so complete that the disease seemed to have entirely disappeared from the Station orchard. This Spring the Kieffers and LeContes although blooming very heavily were entirely free from blight. A few Bartlett trees blooming two or three weeks later received the contagion from some source and nearly all the flower clusters developed the blight so virulently that notwithstanding repeated prunings the trees were nearly killed before it could be checked. These blighting Bartletts caused a few "growing tip" infections in the Kieffers and caused the blighting of some clusters of apple blossoms.

### PLUMS.

Most of the varieties of plums in the Station orchard bore a full crop this year and it is now possible to form an estimate as to their value for this region. Some light has also been obtained on the vexed question of the nomenclature of the Japanese varieties. The trees for this orchard were obtained from a number of prominent nurseries in different parts of the West and South and in Bulls. 98 and 106 the names under which they were purchased were used in all cases. It now appears that as represented here (trees purchased in Jan. 1896), the following are all Abundance:

Botan from T. V. Munson & Son, Denison, Tex.

Yellow Fleshed Botan, P. J. Berckmans Co., Augusta, Ga.

Berger, from Stark Bros., Louisiana, Mo.

The following while differing slightly among themselves are for all practical purposes the same as Chabot. This kind like Abundance is quite variable and seems to be represented by more or less distinct strains.

Babcock, from G. L. Tabor.

Baileys Japan, from G. L. Tabor.

Hattankio, from T. V. Munson & Son.

Munson, from P. J. Berckmans Co.

Yellow Japan, from G. L. Tabor.

Red Nagate, from G. L. Tabor seems to be the same as Red June from Stark Bros; and Botan of Tabor is the Berckmans.

As plums are now usually classified our varieties belong to five different races or types, the Japanese and four natives. These are the Americana type, the Wild Goose type, the Wayland type and the Chicasaw type. The domestica type which includes the European plums and prunes does not succeed here and none were planted.

*The Americana Plums:* The plums of this type have been developed from the wild plum of the North and East. They are useful for planting at the far North on account of their great hardiness to cold but they are not at home here. So far as we have tried them the trees are poor growers, very short lived and unproductive.

At present they are represented in the orchard only by Hawkeye and Rockford though several other kinds were planted that have since died. Although blooming very late long after danger from frost is over, they bore no fruit at all this season. The planting of varieties of this type is not advised for this State.

*The Wild Goose Plums:* The ancestry of this group of plums is still a matter of doubt. Some authorities have supposed them to be hybrids between the Americans and Chicasaws but there is no proof of this theory except their somewhat intermediate characters, and on the whole it seems more probable that they are descended from some of the Southern wild plums. The native plums of our Southern woods have been strangely neglected by botanists and as yet we have very little knowledge of their number or relationships. It is certain that in the red clay soil of the granitic hills north of Auburn, a wild plum occurs abundantly that has all the characteristics of this group of cultivated kinds. Botanists to whom specimens of it have been submitted unite in pronouncing it *Prunns hortulana*, the supposed hybrid parent of the Wild Goose plums, but there is no conceivable reason for supposing that this commonly occurring native plum is a hybrid. It has so far been impossible to determine its true botanical position.

Before the introduction of the Japanese kinds this race of plums was our chief dependence at the South for market sorts. While they have been largely supplanted in popular favor by these new introductions they have some very good qualities and should not be overlooked in planting for home use and local markets. For distant shipment they are doubtless inferior to the best of the Japs, still they are likely to long continue to hold a recognized place in the market. As a rule they bloom rather late so as to be comparatively free from injury from frost. They succeed admirably in Middle and North Alabama, but are not so well adapted to the coast region. The following kinds are in the Station orchard: Charles Downing.—This is a medium sized plum of very fine quality, fairly productive, late, ripening July 10 and a very late bloomer. Unfortunately the tree is rather

a feeble grower and it does not seem quite at home. It would succeed better farther North. It is worth planting for home use on account of its fine quality and because it extends the season for this class of plums.

Milton: This is a fine plum blooming a day or two later and ripening three or four days earlier than the Wild Goose. This season the first picking was on June 9. It is an oblong plum, darker, richer red than Wild Goose and marked with large white dots. The flesh is firmer and it hangs on the tree better than the Wild Goose. It is clearly superior to that well known kind and is, every thing considered, the best variety of its class that we have tested. It was one of the very few kinds carrying a full crop in 1899.

President Wilder: This is a high flavored, medium sized red plum, ripening late in June. It does not seem to be very productive and like Charles Downing would probably do better farther North. It can not be recommended here except, perhaps, to keep up a succession and fill the gap between Wild Goose and Charles Downing.

Whitaker: This is much like Wild Goose and ripens at about the same season, possibly averaging two or three days later. It is hardy and productive, bearing a full crop in 1899 and also this season, but it is so much like Wild Goose that there is no need to plant both kinds. It will take farther experience to decide which of the two is preferable.

Wild Goose: Too well known to require extended comment. It succeeds well in Central and North Alabama and is very prolific when planted near other kinds. It requires cross pollination and does not bear well if planted by itself. It begins ripening here early in June in ordinary seasons and continues in season for nearly three weeks. It failed to bear in 1899 though others of this class carried a full crop.

**Wooten:** A small oblong red plum, ripening ten days later than Wild Goose. It has little to recommend it except hardness and productiveness as the quality is poor. It ripened a full crop in 1899.

*The Wayland Plums:* These resemble the Wild Goose type somewhat closely but they bloom later and ripen decidedly later than most of those kinds and seem adapted to a range of country a little farther South. What wild species they are descended from is uncertain. They cannot be recommended for shipment but are desirable for the home orchard on account of the sureness of the crop, an entire failure being almost unknown, and because of their late ripening which will prolong the plum season till the first of September. In quality they are not equal to the best kinds of the Wild Goose type, but they are useful for canning, jellies and preserves. They are represented in the Station orchard by two kinds, Wayland and Golden Beauty. The former is bright cherry red, and rather milder in flavor and is probably preferable where only one is to be planted but the Golden Beauty is very prolific and it is a few days later. Both kinds ripen in August, often lasting to early September. The crop was lighter this year than it has been in five years owing to heavy and continued rains during the blooming season that prevented pollination. A failure from Spring frosts is almost or quite unknown.

*The Chicasaw Plums:* The varieties of this type in cultivation are simply selections from the best of our native "old field" plums and have little to recommend them for general planting. They mostly bloom so early as to be in great danger from Spring frosts and they are too soft and small to be of much value for shipment. A few trees of the earliest kinds may be useful in the home garded as they ripen before the other kinds. They are

represented in the Station orchard by the following three kinds:—Emerson: A small red plum, very early but of no great value. This season the crop all rotted when half grown. Lone Star: Much like Emerson of no value. Transparent: A medium sized yellow plum of nice sweet, delicate flavor. It is the best of the lot but cracks badly in wet weather.

*The Japanese Plums*: This is by far the most important type of plum for this region. For commercial orchards they are second in value only to peaches and with properly selected varieties the crop is surer than peaches, being less liable to injury from Spring frosts and from rot. There has been much confusion in regard to the names of the varieties and as noted on page 175, several of the supposed kinds in the Station orchard prove to be identical. The following sixteen kinds seem to be sufficiently distinct. They are mentioned in alphabetical order.

Abundance (this equals Botan of some, Yellow fleshed Botan, and in our orchard Berger): This is the best known and most widely planted of any of the Japanese plums. It blooms with peaches but usually holds a number of buds in reserve that open if the first blooming is killed so that an entire failure of the crop is rare. It is a handsome red plum with clear transparent skin that is yellow under the red, of very fine sweet flavor, the flesh becoming soft and juicy when fully ripe. Picked when still firm it ships well. It began ripening this year the middle of June and lasted two weeks. It is usually free from rot. Perhaps its greatest fault is a tendency to overbear, making it necessary to thin freely to secure good sized fruit. It is the best plum of its season and is strongly recommended for general planting.

Berckmans (Botan of some): This is another large

red plum very similar to Abundance in tree and fruit. It was formerly confused with it under the name of Botan. The color is a little duller, being underlaid with green instead of yellow, the size averages a little larger, but the quality is not so good. It ripens at about the same season. It is a plum of some merit but not so good as Abundance.

Burbank: This contests with Abundance for the first place in popularity as a market plum. It is a little larger and even richer in color, has firm, high flavored flesh and ripens an average of a week to ten days later than Abundance, although occasional specimens ripen nearly as early as that kind. The tree is thrifty with a spreading habit of growth quite different from that of most of the Japanese plums. Like Abundance it is a great bearer and needs heavy thinning. In some seasons it rots badly which is its only fault. It is recommended for general planting.

Blood plum No. 4: This is of the Satsuma type but inferior to that kind. It is not worth planting.

Chabot (Babcock, Bailey, Hattankio, Munson and Yellow Japan of our orchard belong here): This is a large red plum with yellow under-color. It is late, ripening here about July 10. It is a good shipper, having firm flesh of fairly good quality and it is usually free from rot. The tree is a good grower. It is recommended for general planting though possibly it should be replaced by Orient.

Hale: Young, only two years planted, but they did not fruit well this season. The few fruits secured were rather disappointing. Final judgment will have to be suspended.

Kelsey: This is the largest and in some respects the finest of the Japanese plums but it has two such serious faults that its planting cannot be advised in this State.



It blooms so early that the crop is usually killed, and it rots very badly. Its season is late, middle to last of July.

**Kerr:** This is a remarkably good plum whose valuable qualities seem to have been overlooked by nursery men and orchardists. It is the earliest of our really good plums ripening here about the first of June. It is large, rich yellow, with firm flesh of high quality. It blooms rather late and the tree is a good grower. It is strongly recommended for both home use and market.

**Long Fruited:** This is a small red plum with very firm flesh. It ripens a few days earlier than Kerr. The tree with us has not been thrifty. The quality is fairly good but the size is too small for market.

**Maru:** This is a red plum about the size of Abundance and ripening a few days later. The quality is poor and it rots very badly. It is not worth planting.

**Normand:** This is a large yellow plum of good quality, ripening the last of June or first of July, between Burbank and Chabot. Its color is somewhat against it for market, but it is useful in filling the gap between these two kinds, and it is in every way worthy of planting.

**Orient:** This is very much like Chabot but it seems to be distinct, and to be an improvement on that kind, being brighter colored, slightly larger and two or three days earlier. It is strongly recommended especially for market planting.

**Red June (Red Nagate of some):** This is a very showy, handsome red plum ripening at least a week earlier than Abundance. It is a good shipper and very free from rot. It is not as good in quality as the Abundance but it combines more desirable qualities for a market plum than any of the others. It blooms late and the tree is vigorous and productive.

**Satsuma:** This is a large plum with dull red mottled skin but bright blood red flesh. When fully ripe the quality is very fine. It cannot be recommended for market on account of its early blooming habit which makes the crop too uncertain, but it should be included in plantings for home use on account of its superior quality especially when cooked. It is one of the finest fruits grown for canning and for jelly on account of its brilliant color and peculiarly rich, pleasant flavor. It ripens about the first of July.

**Willard:** This plum has nothing to recommend it but earliness. With us it is no earlier than Kerr and not nearly as good. The tree here is a poor grower and unproductive.

**Yosebe:** This is the earliest Japanese plum we have tested, ripening a few days earlier than Keer and slightly in advance of Longfruited. It is a small bright red plum with firm flesh, free from rot and of very fair quality. The tree blooms late and is thrifty and productive. It is probably too small for a profitable market fruit, yet its earliness, high color and other good qualities make it at least worth a farther trial.

*Hybrid Plums:* The following kinds are hybrids between the Japanese plums and some of the other races. While they are very interesting and suggest great possibilities for future improvement it cannot be said that any of them fully come up to the standard for a market plum.

**Golden (Gold of Stark Bros.):** This is a hybrid between the Japanese and the Chicasaw plums. It turns golden yellow long before it is ripe and the loaded trees are very showy and beautiful. When ripe it is a light bright red at least on the side toward the sun. The quality is poor and watery, and this season much of the crop was lost through sunburn and rot. On the whole it is a disappointment.

**Excelsior:** Said to be a hybrid between the Japanese and Wild Goose races. It is a good sized, early, dull red plum of better quality than Golden. The tree is a fine grower and very productive. It is said to do well at the far South. It is perhaps worthy of farther trial. The Wild Goose characteristics seem to predominate in the fruit of this plum as the Chicasaw does in that of Golden.

**Wickson:** A hybrid between Kelsey and *Prunus Simmoni*, which latter parent the tree greatly resembles. This is truly a magnificent plum, larger and handsomer than any of those mentioned above. Its one great fault is that it blooms too early for safety. It ripens about the first of July, but this year there were only two or three specimens to the tree. In fact we have never secured a full crop from it.

*Lists of Plums for General Planting in Alabama.* As a short list including only the very best plums for market we suggest the following mentioned in the order of ripening. They will cover the period from the first of June to the middle of July with a short break about the first of July. Kerr, Red June, Abundance, Burbank, and Orient. A large orchard of these five plums, if properly managed, could hardly fail to be profitable. Abundance and Burbank bloom together and should be planted near each other in order to secure cross pollination, while Kerr, Red June and Orient all bloom about together but a few days later. For a longer list add Yosebe for very early, Berckmans, Normand and Chabot.

For a full list for home use and local market, plant all of the above and add Transparent, Milton, Wild Goose, Satsuma, Wickson, Wayland and Golden Beauty.

*The Blooming Season of Plums:* As has been noted in previous Bulletins the blooming season of plums is especially import since many, or perhaps most, of the

varieties are infertile to their own pollen and require cross pollination in order to bear fruit. For this reason plums should not be planted in large blocks of one variety but rows of one kind should be alternated with rows of one or more others, taking care to mate together kinds that bloom at approximately the same season. The notes given below on the blooming season for 1900 show a rather close agreement in the sequence of varieties with observations recorded for other seasons at this place, indicating that there is but little variation in this respect from year to year, although the actual season of blooming varies quite widely in different seasons. The sequence observed here however is not the same that is recorded for the same varieties in more northern localities, (see particularly the Vermont Bulletins and Reports). It is hard to see what should cause this difference in the comparative behavior of varieties in the two sections.

*Notes on the blooming of plums in 1900.*

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Abundance .....		buds white.....	full bloom.....	Mostly fallen ..		
Babcock* .....		buds separated.	full bloom.....	falling .....		
Bailey* .....		buds separated	full bloom.....	falling.....		
Breckmans .....		buds white.....	full bloom.....	falling.....		
Berger † .....		buds white.....	full bloom.....	mostly fallen..		
Blood No. 4 .....	first blooms.....	nearly full bloom.....	flowers falling.	fallen .....		
Potan (Tabor) † .....		buds white.....	full bloom.....	falling.....		
Botan (Munson) † .....		buds white.....	full bloom.....	mostly fallen..		
Burbank .....		first blooms.....	blooming.....	falling.....		
Chabot .....		buds separated.	blooming.....	falling .....		
Chas. Downing .....		nearly dormant.....	buds separating	buds separated	first blooms...	full bloom. ....
Earliest of all.....		dormant.....	nearly dormant.....	first blooms...	nearly full bloom .....	
Emerson .....	first blooms.....	full bloom.....	falling .....	fallen, fruits setting.		
Excelsior .....		first blooms.....	full bloom falling.	fallen .....		

Golden—(Gold)	.....	buds separated.	blooming.....	mostly fallen...	.....	.....
Golden Beauty.	.....	dormant.....	buds separating nearly full bloom	buds separated.	buds white...	blooming.....
Hale.	.....	first blooms...	.....	mostly fallen ..	.....	.....
Hattankio*	.....	buds separated	blooming ..	mostly fallen ..	.....	.....
Hawkeye	.....	dormant.....	dormant .....	dormant .....	dormant .....	nearly dormant.....
Kelsey	.....	nearly full bloom.....	nearly full bloom.....	fallen .....	.....	.....
Kerr	.....	buds separated	nearly full bloom ..	full bloom .....	.....	.....
Lone Star	.....	buds white	full bloom.....	fallen .....	.....	.....
Long fruited.	.....	dormant .....	dormant.....	first blooms many buds still dormant	first blooms ..	full bloom ..
Maru.	.....	dormant .....	dormant.....	nearly dormant...	first blooms, most buds not separat'd	nearly full bloom .....
Milton	.....	nearly dormant ..	buds separating	first blooms ..	full bloom ..	.....
Munson *	.....	buds separated.	blooming ..	.....	.....	.....
Normand	.....	buds white ..	full bloom ..	falling ..	.....	.....
Orient	.....	buds separated.	first blooms ..	mostly fallen...	.....	.....
Pres. Wilder.	.....	nearly dormant.....	buds separating	first blooms ..	blooming...	full bloom ..
Red nagate	.....	nearly dormant ..	buds white.....	full bloom .....	full bloom ..	first blooms ..

*Notes on the blooming of plums in 1900.—Con'd.*

	March 6.	March 10.	March 14.	March 25.	March 29.	April 6.
Rockford	dormant	dormant	dormant.	dormant	nearly dormant	first blooms ..
Satsuma	first blooms badly killed in Feb.	nearly full bloom.	full bloom and falling	leaves half grown.	.....	.....
Transparent	.....	buds separated	first blooms	mostly fallen	.....	.....
Wayland	.....	buds separated	buds separated	first blooms	first blooms ..	full bloom ..
Whitaker	.....	buds separating	buds separated	nearly full bloom	full bloom ..	.....
Wickson	first blooms badly killed in Feb.	.....	full bloom	fallen	.....	.....
Wild Chicasaw	first blooms	nearly full bloom	full bloom and falling	.....	.....	.....
Wild Goose	.....	buds separating	buds separated	nearly full bloom	full bloom ..	.....
Willard	.....	nearly dormant	nearly dormant	nearly dormant	first blooms ..	blooming ..
Woolen	.....	buds separating	buds separated	nearly full bloom	full bloom ..	.....
Yellow Botan +	.....	buds white	nearly full bloom	falling	.....	.....
Yellow Japan *	.....	buds separated	blooming	falling	.....	.....
Yosebe	.....	dormant	dormant	first blooms, most buds not separated	first blooms ..	nearly full bloom ..

\* Equals Chabot.

+ Equals Abundance.

‡ Equals Berckmans.

## SAN JOSE SCALE.

In Bulletin 106 it was noted that in the plum orchard planted in 1896 two trees proved to be infested with scale, and that from this center of infection it was slowly spreading to other trees in the orchard. At the close of the growing season of 1899 it had developed sufficiently to conspicuously whiten large areas on the trunk and larger branches. It had not spread to the twigs and smaller branches and it had so far interfered but little with the growth and vigor of the trees. During February, 1900, this entire orchard was thoroughly sprayed with a 20% mechanical mixture of kerosene and water. A little later one of the originally infested trees was again sprayed with undiluted crude petroleum. The crude petroleum was also applied to two infested peach trees and to a number of apple trees. In no case did it do any injury.

The result of this treatment simply goes to confirm the truth of the following two propositions: 1st, that when a tree is once infested with scale it is almost impossible to entirely eradicate it. 2nd, that by spraying with kerosene or crude petroleum its numbers can be so reduced that it does the trees no harm. The spraying has probably not exterminated the scale on a single tree where it had gained a lodgment, but there are left only a few scattered individuals on any of the trees. These facts have come to be quite widely recognized and they should be made the basis for the treatment of every outbreak of the scale. When it is first discovered in a new locality, if it is confined to a few trees or even to one or more entire orchards, by all means cut them out at once and burn them, for this is the only sure way of stamping out the pest. On the other hand in communi-



ties where it is known to occur somewhat widely it is needless to cut down infested trees for if taken in time the scale can be so controlled by annual or even biennial sprayings that it will do little if any harm. Of course the spraying is a rather heavy expense and the occasion for it should be avoided by taking every precaution to keep the premises clear of this pest.

BULLETIN No. 113.

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FEBRUARY, 1901.

ALABAMA.

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## Co-operative Experiments with Cotton in 1899-1900.

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By J. F. DUGGAR, Agriculturist.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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# CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1899 and 1900.

BY J. F. DUGGAR.

These experiments were conducted under the direction of the Agricultural Department of this Station in 1899 and 1900. These tests in 1899 were made by farmers in nineteen localities; the tests made in 1900 were conducted in eighteen localities, not including in this count the few experimenters who failed to report results.

The method of conducting the experiments was the same as in former years. The plots were each one-eighth acre in area.

The following is the list of those who made experiments in 1899 and 1900 and who reported results.

Name.	Post Office.	County.	Page
Agricultural School, . . .	Hamilton. . . . .	Marion—	50
Autrey, A. . . . .	Berneys. . . . .	Talladega—	50
Ballard J. L. . . . .	Jackson. . . . .	Clarke—	40
Bevill, W. C. . . . .	Bevill. . . . .	Choctaw—	38
Borland, T. M. . . . .	Dothan. . . . .	Henry—	46
Chappell, C. A. . . . .	Dillburg. . . . .	Pickens—	51
Chism, W. T. . . . .	Vick. . . . .	Bibb—	20
Culver, J. W. . . . .	Jackson. . . . .	Clarke—	40
Cunningham, E. L. . . . .	Furman. . . . .	Wilcox—	11
Cory, A. F. . . . .	Evergreen. . . . .	Conecuh—	52
Daffin, E. J. . . . .	Tuscaloosa. . . . .	Tuscaloosa—	17
Duncan, J. S. . . . .	Maple Grove. . . . .	Cherokee—	13
Experiment Station. . . .	Auburn. . . . .	Lee—	24
Foster, J. D. . . . .	Auburn. . . . .	Lee—	27
French, J. W. . . . .	Gordo. . . . .	Pickens—	15

Name	Post Office	County	Page.
Fulton, W. F.....	Collinsville.....	DeKalb—	7
Funke, F.....	Tuscumbia.....	Colbert—	50
Freeman, G. W.....	Maple Grove.....	Cherokee—	13
Harris, Jno. T., Jr....	Oak Bowery.....	Chambers—	51
Ingram, W. N.....	Marvyn.....	Russell—	51
Ingram, W. N.....	Opelika.....	Lee—	32
Jarrett, R. H.....	Sterrett.....	Shelby—	51
Jones, T. K.....	Greensboro.....	Hale—	51
Mason, C. H.....	Wilson.....	Escambia—	44
McClure, G. L.....	Garland.....	Butler—	43
Melton, E.....	Hugent.....	Fayette—	19
McAlpine, J. R.....	Boligee.....	Greene—	59
McIntyre, P. M.....	Abbeville.....	Henry—	52
Purifoy, W. M.....	Snow Hill.....	Wilcox—	10
Rivers, C. E.....	Hurtsboro.....	Russell—	35
Rouse, D. H.....	Greenville.....	Butler—	52
Slaton, J. P.....	Notasulga.....	Macon—	21
Thomason, T. J....	Kaylor or Ranburn....	Randolph—	29
Troyer, A. M.....	Calhoun.....	Lowndes—	36, 52
Watkins, J. C.....	Burn Corn.....	Monroe—	33
Weems, J. A.....	Union Springs.....	Bullock—	52

## THE FERTILIZERS USED.

These consisted of high grade acid phosphate guaranteed to contain at least 14 per cent. of available phosphoric acid.

The following table gives the plan of the experiment and the composition of the fertilizers employed:

*Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used, and composition of each mixture.*

Plot No.	FERTILIZERS.		MIXTURE CONTAINS.			Cost of mixture, per ton.
	Amount per acre.	KIND.	Nitrogen.	+ Available phosphoric acid.	Potash	
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	
1	200	Cotton seed meal.....	13 58	5 76	3 54	\$ 19.00
		<i>In 100 lbs s c. meal.*</i>	6.79	2 88	1 77	
2	240	Acid phosphate.....		36 12		12.50
		<i>In 100 lbs. acid phos</i>		15.05		
4	200	Kainit.....			24 60	13.75
		<i>In 100 lbs kainit.</i>			12.90	
5	200	Cotton seed meal.... }	13.58	41.88	3.54	15.45
	240	Acid phosphate..... }				
		<i>In 100 lbs. above mixt.</i>	8.09	9.52	.80	
6	200	Cotton seed meal.... }	13 58	5.76	28 14	16.88
	200	Kainit..... }				
		<i>In 100 lbs. above mixt</i>	8.89	1.44	7.03	
7	240	Acid phosphate .... }				13.09
	200	Kainit..... }				
		<i>In 100 lbs. above mixt</i>		8.21	5.59	
9	200	Cotton seed meal.... }	13 58	41 88	28.14	14.94
	240	Acid phosphate..... }				
	200	Kainit..... }				
		<i>In 100 lbs above mixt</i>	2.12	6.54	4.39	
10	200	Cotton seed meal.... }	13 58	41 88	15 84	15.11
	240	Acid phosphate..... }				
	100	Kainit..... }				
		<i>In 100 lbs. above mixt</i>	2.59	7.75	2.93	

\* Average of many analyses.

+ Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by  $1\frac{3}{4}$ .

The phosphate and cotton seed were purchased at market prices. Most of the kainit was donated by the German Kali Works.

In determining the increase over the unfertilized plots, the yield of the fertilized plots, Nos. 4, 5, 6 and 7, is compared with both unfertilized plots, lying on either side, giving to each unfertilized plot a weight inversely proportional to its distance from the plot under comparison. This method of comparison tends to compensate for variations in the fertility of the several plots.

It should be remembered that seasons, as well as soils, determine the effects of fertilizers, so that to be absolutely reliable a fertilizer experiment should be repeated for several years on the same kind of soil. Abnormal weather conditions in 1899 and 1900 resulted in an unusually large proportion of inconclusive experiments.

#### THE WEATHER IN 1899 and 1900.

The following data are taken from the records of the Alabama Section of the Weather Bureau for 1899 and 1900 and give average results of a number of stations:

	1899.	1900.
Rainfall for April, inches.....	2.80	9.06
Rainfall for May, inches.....	2.03	2.64
Rainfall for June, inches.....	2.54	11.80
Rainfall for July, inches ..	6.76	4.93
Rainfall for August, inches.....	3.68	2.89
Rainfall for September, inches.....	.66	4.00
Rainfall for October, inches.....	2.18	5.64
Rainfall for November, inches.....	3.04	3.88

It will be seen from the above that the spring and early summer of 1899 were very dry. Complaints of drought in that year were general. In 1900 an excessive precipitation in April and June greatly injured crops, and in addition there was in many localities a severe drought in August.

Two more unfavorable seasons in immediate succession seldom occur.

EXPERIMENTS MADE BY W. F. FULTON, LARIMORE OR  
COLLINSVILLE, DEKALB COUNTY.

*Dark gray, mulatto, or reddish, stiff soil; subsoil red clay.*

An experiment with cotton has been conducted on this farm in Big Wills Valley for three years in succession on land cleared about three-quarters of a century ago. The crop preceding the cotton experiments of both 1899 and 1900 was corn. The early part of the summer of 1899 was rather dry; in 1900 "from the time the cotton was planted until it was laid by my notes show almost continuous rain,—the wettest season in the knowledge of the oldest inhabitant."

The results for 1898 were printed in Bulletin No. 102. Those for 1899 and 1900 are given in the following table:



*Larimore or Collinsville experiment with cotton.*

Plot No.	FERTILIZERS.		1899		1900	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal.....	648	208	544	0
2	240	Acid phosphate.....	760	320	880	336
3	00	No fertilizer.....	440	.....	544	.....
4	200	Kainit.....	648	208	666	107
5	200	Cotton seed meal.....	880	434	1120	550
	240	Acid phosphate.....				
6	200	Cotton seed meal.....	736	287	920	337
	200	Kainit.....				
7	240	Acid phosphate.....	856	404	1064	463
	200	Kainit.....				
8	00	No fertilizer.....	456	.....	608	.....
9	200	Cotton seed meal.....	976	520	1208	600
	240	Acid phosphate.....				
10	200	Kainit.....	912	456	1032	424
	240	Acid phosphate.....				
	100	Kainit.....				

Increase of seed cotton per acre when cotton seed meal was added:

	1899	1900
To unfertilized plot .....	208 lbs.	0 lbs.
To acid phosphate plot .....	114 lbs.	214 lbs.
To kainit plot .....	82 lbs.	230 lbs.
To acid phosphate and kainit plot.....	116 lbs.	132 lbs.
<b>Average increase with cotton seed meal.....</b>	<b>130 lbs.</b>	<b>144 lbs.</b>

**Increase of seed cotton per acre when acid phosphate was added :**

To unfertilized plot .....	320 lbs.	336 lbs.
To cotton seed meal plot.....	126 lbs.	550 lbs.
To kainit plot.....	233 lbs.	263 lbs.
To cotton seed meal and kainit plot . . . . .	233 lbs.	263 lbs.
<hr/>		<hr/>
<b>Average increase with acid phosphate... ..</b>	<b>219 lbs.</b>	<b>378 lbs.</b>

**Increase of seed cotton per acre when kainit was added :**

To unfertilized plot .....	205 lbs.	107 lbs.
To cotton seed meal plot.....	79 lbs.	337 lbs.
To acid phosphate plot.....	84 lbs.	132 lbs.
To cotton seed meal and acid phosphate plot . . . . .	86 lbs.	50 lbs.
<hr/>		<hr/>
<b>Average increase with kainit.....</b>	<b>116 lbs.</b>	<b>157 lbs.</b>

The principal need of this soil, clearly shown in each of three tests, is for phosphate, which has paid a large profit, whether employed alone or in combination with any of the other materials. The increase attributable to phosphate in each of the three years is respectively 464, 219, and 378 pounds of seed cotton per acre. Cotton seed meal usually increased the yield more than enough to cover its cost, the averages for the 3 years being respectively 152, 130, and 144 pounds of seed cotton. Its relatively slight effect suggests the advisability of reducing the amount of cotton seed meal, of which about half as much as of phosphate might be used for cotton.

Kainit was the least beneficial on this soil of the ingredients of the complete fertilizer and the figures indicate that its addition to the mixture of phosphate and kainit was not profitable.

EXPERIMENT MADE BY W. M. PURIFOY, 2 MILES NORTH-  
EAST OF SNOW HILL, WILCOX COUNTY.

*White bald prairie; subsoil, white rotten limestone.*

This experiment was made in 1899 on land especially favorable to the development of black rust of cotton. The land was not broken until May 25, when it was bedded with a one-horse plow. "Many stalks had nothing on them on account of coming up too late. Extreme drought ruined the experiment."

The table on page 11 gives the yields and the subjoined analysis of results of Mr. Purifoy's tests, both in 1898 and 1899, shows the increase attributable to each fertilizer, when used alone or in combinations under cotton growing on poor white prairie soil.

Increase of seed cotton per acre when cotton seed meal was added:

	1898.	v899.
To unfertilized plot .. .	128 lbs.	144 lbs.
To acid phosphate plot .. .	27 lbs.	16 lbs.
To kainit plot .. .	227 lbs.	144 lbs.
To acid phosphate and kainit plot.	141 lbs.	128 lbs.
<hr/>		
<b>Average increase with cotton seed meal.....</b>	<b>131 lbs.</b>	<b>100 lbs.</b>

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .. .	200 lbs.	208 lbs.
To cotton seed meal plot.....	99 lbs.	48 lbs.
To kainit plot.. .	209 lbs.	240 lbs.
To cotton seed meal and kainit plot.	123 lbs.	224 lbs.
<hr/>		
<b>Average increase with acid phosphate.....</b>	<b>158 lbs.</b>	<b>180 lbs.</b>

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	27 lbs.	0 lbs.
To cotton seed meal plot.....	72 lbs.	0 lbs.
To acid phosphate plot .....	18 lbs.	32 lbs.
To cotton seed meal and acid phosphate plot ..	96 lbs.	176 lbs.

**Average increase with kainit..... 41 lbs. 52 lbs.**

In the above paragraphs the results of Mr. Purifoy's experiment in 1898 are republished to show the close correspondence between the results of the two years, both tending to indicate that the phosphate was more beneficial than cotton seed meal and that kainit was of least effect.

*Snow Hill and Furman experiments with cotton on white bald prairie.*

Plot No.	FERTILIZERS.		SNOW HILL 1899.		FURMAN. 1900.	
	Amount per acre	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
1	Lbs. 200	Cotton seed meal.....	Lbs. 144	Lbs. 144	Lbs. 480	Lbs. 80
2	240	Acid phosphate.....	208	208	480	80
3	00	No fertilizer.....	00	.....	400	.....
4	200	Kainit.....	00	.....0	378	—27
5	200	Cotton seed meal.....	192	192	664	258
6	240	Acid phosphate.....	144	144	488	79
7	200	Cotton seed meal.....	240	240	616	204
8	240	Acid phosphate.....	00	.....	416	.....
9	200	Kainit.....	368	368	624	208
10	200	Cotton seed meal.....	416	416	616	200
	240	Acid phosphate.....				
	100	Kainit.....				

**EXPERIMENT MADE IN 1900 BY E. L. CUNNINGHAM, 6 MILES  
EAST OF FURMAN, WILCOX COUNTY.**

*White prairie, the surface dark gray; sub-soil white rotten limestone.*

The original growth, cleared about 30 or 40 years ago, is reported as oak and hickory with some short-leaf pine. The field was in cotton in 1897 and 1898 and uncultivated in 1899.

The depth of plowing was 5 or 6 inches. On Plot 5 there was considerable black rust, but very little on Plots 9 and 10, where a complete fertilizer containing kainit was used. The stand was full and uniform. There was too much rain.

The yields are given in the table above.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ..	80 lbs.
To acid phosphate plot ..	178 lbs.
To kainit plot.....	106 lbs.
To acid phosphate and kainit plot.....	4 lbs.

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**Average increase with cotton seed meal, - - 92 lbs.**

Increase of seed cotton per acre when acid phosphate was used.

To unfertilized plot ..	80 lbs.
To cotton seed meal plot ..	178 lbs.
To kainit plot ..	231 lbs.
To cotton seed meal and kainit plot.....	129 lbs.

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**Average increase with acid phosphate, - - 130 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot.....	—27 lbs.
To cotton seed meal plot .....	—1 lbs.
To acid phosphate plot ..	124 lbs.
To seed cotton meal and acid phosphate plot...	—50 lbs.

Average increase with kainit, - - - - - 12 lbs.

Mr. Cunningham's experiment, like both of the tests made by Mr. Purifoy, on the same class of land, white prairie, indicates that phosphate was most needed. The largest yield was made with a mixture of cotton seed meal and phosphate. Kainit did not increase the yield, though it did seem to somewhat restrain the rust on Plots 9 and 10.

It should be noted that white prairie soil was not very responsive to commercial fertilizers and that none of these paid a very large profit.

Although phosphate was undoubtedly useful in each of these experiments, its effects were far less notable than the favorable influence that is exerted by adding suitable vegetable matter to this class of soils. We cannot yet recommend the use of phosphate on these soils, believing that the same money invested in the seed of melilotus or of other renovating plant would be more profitably spent.

EXPERIMENTS MADE BY J. S. DUNCAN ON G. W. FREEMAN'S  
FARM, 1½ MILES SOUTHWEST OF MAPLE GROVE,  
CHEROKEE COUNTY.

In 1899 the test was made on gray sandy upland, with red subsoil; in 1900 on light alluvial second bottom of a dark gray color, with red subsoil. Both fields had been cleared for more than a quarter of a century. The

cotton experiment of 1899 was preceded by cotton, that of 1900 by corn.

In 1899 the summer was excessively dry, in 1900 excessively wet.

*Maple Grove experiment with cotton.*

Plot No.	FERTILIZERS.		MAPLE GROVE. 1899.		MAPLE GROVE. 1900	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots	Yield seed cotton per acre.	Increase over unfertilized plots
1	Lbs. 200	Cotton seed meal.....	Lbs. 800	Lbs. 176	Lbs. 1036	Lbs. 220
2	240	Acid phos-phate.....	752	128	932	116
3	00	No fertilizer.....	624	.....	816	.....
4	200	Kainit.....	616	—43	920	108
5	200	Cotton seed meal.....	960	266	992	181
	240	Acid phosphate.....				
6	200	Cotton seed meal.....	804	175	1032	223
	200	Kainit.....				
7	240	Acid phosphate.....	776	12	1024	218
	300	Kainit.....				
8	00	No fertilizer.....	800	.....	804	.....
	200	Cotton seed meal.....				
9	240	Acid phosphate.....	1024	224	1060	276
	200	Kainit.....				
10	200	Cotton seed meal.....	992	192	1032	228
	240	Acid phosphate.....				
	100	Kainit.....				

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot ..	176 lbs.	220 lbs.
To acid phosphate plot.....	138 lbs.	65 lbs.
To kainit plot .....	218 lbs.	117 lbs.
To acid phosphate and kainit plot.	212 lbs.	58 lbs.

**Average increase with cotton seed meal..... 186 lbs. 115 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .. . . . .	128 lbs.	116 lbs.
To cotton seed meal plot .. . . . .	90 lbs.	—39 lbs.
To kainit plot. . . . .	55 lbs.	112 lbs.
To cotton seed meal and kainit plot.	49 lbs.	53 lbs.

<b>Average increase with acid phosphate. . . . .</b>	<b>81 lbs.</b>	<b>61 lbs.</b>
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Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. . . . .	—43 lbs.	106 lbs.
To cotton seed meal plot .. . . . .	—1 lb.	3 lbs.
To acid phosphate plot. . . . .	—116 lbs.	102 lbs.
To cotton seed meal and acid phosphate plot .. . . . .	—42 lbs.	95 lbs.

<b>Average increase (or decrease[—]) with kainit. . . . .</b>	<b>—51</b>	<b>77 lbs.</b>
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In both years cotton seed meal was the most important fertilizer for cotton; phosphate afforded a small increase, possibly because of abnormal weather conditions; kainit was useless on upland in 1899 and scarcely profitable in 1900 on second bottom land.

EXPERIMENT MADE BY J. W. FRENCH, 3 MILES NORTH OF GORDO, PICKENS COUNTY.

This test was conducted in 1899 on gray upland, and in 1900 on dark sandy upland, both having red subsoils, rather retentive of water. The cotton experiment of 1899 was preceded by corn, that of 1900 by cotton. In both cases the tests were on old fields, cleared of pines and reclaimed four to seven years before the experiments began.

The former season was exceedingly dry; the latter, "the most unfavorable ever known, first too wet and then too dry." The stand was reported as excellent.



*Gordo experiment with cotton.*

Plot No.	FERTILIZERS.		1899.		1900.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal .....	536	200	696	312
2	240	Acid phosphate .....	848	512	568	184
3	00	No fertilizer .....	336		384	
4	200	Kainit .....	360	38	400	11
5	200	Cotton seed meal .....	944	637	728	335
	240	Acid phosphate .....				
6	200	Cotton seed meal .....	528	235	584	188
	200	Kainit .....				
7	240	Acid phosphate .....	736	458	552	149
	200	Kainit .....				
8	00	No fertilzer .....	264		403	
9	200	Cotton seed meal .....	1032	868	868	480
	240	Acid phosphate .....				
	200	Kainit .....				
10	200	Cotton seed meal .....	928	664	818	440
	240	Acid phosphate .....				
	100	Kainit .....				

Increase of seed cotton per acre when cotton seed meal was added :

	1899..	1900.
To unfertilized plot ..	200 lbs.	312 lbs.
To acid phosphate plot.....	125 lbs.	151 lbs.
To kainit plot.....	197 lbs.	175 lbs.
To acid phosphate and kainit plot....	410 lbs.	331 lbs.

**Average increase with cotton seed meal, 238 lbs. 242 lbs.**

Increase of seed cotton per acre when acid phosphate was added :

To unfertilized plot ..	512 lbs.	184 lbs.
To cotton seed meal plot ..	437 lbs.	23 lbs.
To kainit plot ..	420 lbs.	138 lbs.
To cotton seed meal and kainit plot ...	633 lbs.	294 lbs.

**Average increase with acid phosphate, 501 lbs. 160 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot . . . . .	38 lbs.	11 lbs.
To cotton seed meal plot . . . . .	—35 lbs.	—126 lbs.
To acid phosphate plot . . . . .	—54 lbs.	—35 lbs.
To cotton seed meal and acid phosphate plot . . . . .	231 lbs.	145 lbs.

<b>Average increase with kainit,</b>	<b>- -</b>	<b>63 lbs.</b>	<b>—1 lb.</b>
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Phosphate was the material of most importance for the gray soil and it was also needed on the darker soil. Cotton seed meal was first in importance in 1900 and second in 1899. Kainit was useless except in a complete fertilizer, in which combination it was slightly profitable, but never so important as phosphate or cotton seed meal.

EXPERIMENT CONDUCTED BY E. J. DAFFIN, 3 MILES S. OF  
TUSCALOOSA, TUSCALOOSA COUNTY.

This test was made in 1900 on the F. S. Moody farm. The soil is described as second bottom, sandy, and of a reddish gray color; the subsoil, as red clay. The original growth, removed more than half a century ago, is sweet gum, black gum, persimmon, and sassafras. The preceding crop was cotton.

June and July brought an excessive rainfall, interfering with cultivation and August was very dry. There were 1,065 plants per eighth-acre plot. "Red rust" was reported as injurious alike on all plots.

Both cotton seed meal and acid phosphate, whether used alone, or in any combination, greatly increased the yield and afforded a good profit. Kainit was practically ineffective except in combination with the other two fertilizers, where it seems to have increased the yield to a profitable extent; the complete fertilizer, con-

taining kainit (Plot 9) affording an increase greater by 236 pounds of seed cotton per acre than the increment where only phosphate and meal were used together. (Plot 5.)

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .. . . . .	216 lbs.
To acid phosphate plot .. . . . .	356 lbs.
To kainit plot .. . . . .	259 lbs.
To acid phosphate and kainit plot .. . . . .	529 lbs.

**Average increase with cotton seed meal..... 340 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .. . . . .	152 lbs.
To cotton seed meal plot .. . . . .	292 lbs.
To kainit plot .. . . . .	189 lbs.
To cotton seed meal and kainit plot .. . . . .	459 lbs.

**Average increase with acid phosphate..... 273 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. . . . .	26 lbs.
To cotton seed meal plot .. . . . .	69 lbs.
To acid phosphate plot .. . . . .	63 lbs.
To cotton seed meal and acid phosphate .. . . . .	236 lbs.

**Average increase with kainit..... 99 lbs.**

Mr. Daffin also conducted similar tests in 1897 and 1898 on red sandy upland, with red clay subsoil, two and one-half miles east of Tuscaloosa. In both years phosphate was by far the chief need of that soil, but both cotton seed meal and kainit afforded considerable increase, so that the greatest profit was obtained by the use of a complete fertilizer containing all three of these materials.

EXPERIMENT MADE IN 1899 BY E. MELTON, ONE MILE  
WEST OF HUGENT, FAYETTE COUNTY.

*Dark or "mulatto" soil, with red clay subsoil.*

The original growth, removed about 50 years ago, is reported as short-leaf pine, oak, and hickory. The three preceding crops were corn. The plants were free from rust.

As shown in the detailed statement below, phosphate was the fertilizer chiefly needed by this soil, and its use, alone and in every combination, was highly profitable, the average increase attributable to phosphate being 364 pounds of seed cotton per acre. Cotton seed meal was next in importance, affording an average increase of 168 pounds per acre.

The most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Kainit was not needed.

Increase of seed cotton per acre when cotton seed meal was used:

To unfertilized plot ..	128 lbs.
To acid phosphate plot ..	160 lbs.
To kainit plot ..	176 lbs.
To acid phosphate and kainit plot ..	208 lbs.

**Average increase with cotton seed meal..... 168 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..	400 lbs.
To cotton seed meal plot ..	432 lbs.
To kainit plot ..	296 lbs.
To cotton seed meal and kainit plot ..	328 lbs.

**Average increase with acid phosphate..... 364 lbs.**

Increase of seed cotton per acre when kainit was added :

To unfertilized plot . . . . .	72 lbs.
To cotton seed meal plot . . . . .	120 lbs.
To acid phosphate plot . . . . .	—32 lbs.
To cotton seed meal and acid phosphate plot . . . .	16 lbs.
<b>Average increase with kainit . . . . .</b>	<b>44 lbs.</b>

EXPERIMENTS CONDUCTED BY W. T. CHISM, 1 MILE SOUTH-  
EAST OF VICK, BIBB COUNTY.

Both experiments were conducted on dark gray sandy or loamy branch bottom soil, rather retentive of moisture. The earlier experiment was preceded by corn, the later one by cotton.

The field had been cleared about 75 years and the original growth is reported as sweet gum, red and white oak, hickory, ash, poplar, cucumber tree, and a few short-leaf pines, and chestnuts.

The latter part of the season of 1899 was dry and unfavorable and in 1900 there was almost continuous wet weather during the season of cultivation. The soil was worked June 25, 1900, when too wet, by which the experimenter reports that the crop was greatly damaged.

Increase of seed cotton per acre when cotton seed meal was used.

	1899.	1900.
To unfertilized plot . . . . .	256 lbs.	62 lbs.
To acid phosphate plot . . . . .	96 lbs.	77 lbs.
To kainit plot . . . . .	244 lbs.	100 lbs.
To acid phosphate and kainit plot . . . .	92 lbs.	15 lbs.
<b>Average increase with cotton seed meal, .</b>	<b>172 lbs.</b>	<b>64 lbs.</b>

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .. . . . .	104 lbs.	24 lbs.
To cotton seed meal plot.....	—56 lbs.	39 lbs.
To kainit plot .. . . . .	116 lbs.	78 lbs.
To cotton seed meal and kainit plot ..	—24 lbs.	—7 lbs.
<b>Average increase with acid phosphate,</b>	<b>35 lbs.</b>	<b>34 lbs.</b>

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. . . . .	—24 lbs.	—1 lb.
To cotton seed meal plot .. . . . .	—32 lbs.	37 lbs.
To acid phosphate plot .. . . . .	—12 lbs.	53 lbs.
To cotton seed meal and acid phosphate plot .. . . . .	—16 lbs.	—9 lbs.
<b>Average increase with kainit.....</b>	<b>—20 lbs.</b>	<b>20 lbs.</b>

In 1900 cotton seed meal was the only fertilizer that was very effective. In 1899 none of them were decidedly beneficial. On account of the extremely unfavorable weather in both years, it is probable that neither experiment indicates the real needs of this soil, so that we must place these tests in the class of inconclusive experiments.

EXPERIMENT MADE IN 1899 BY J. P. SLATON, 7 MILES SOUTH OF NOTASULGA AND 7 MILES N. E. OF TUSKEGEE, MACON COUNTY.

*Gray sandy upland, with retentive red clay subsoil.*

The field was originally cleared about 75 years ago, and cleared of the second growth about 12 years ago. The original growth was long leaf pine and oak. The preceding crop was cotton.

The cotton did not come up until the first of June and

this late start may have kept the fertilizers from exerting their full effect. The stand was good.

As shown in the table on page 23 and in the detailed statements below, phosphate and cotton seed meal were both effective in nearly every combination. Kainit was not needed.

Mr. Slaton conducted an experiment in 1898 (see Bulletin No. 102) on similar soil. In that year acid phosphate and cotton seed meal were even more profitable than in 1900 and kainit was useless. It seems that this gray soil, with a clay subsoil near at hand, needs only a mixture of acid phosphate and cotton seed meal to produce a profitable cotton crop.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ..	192 lbs.
To acid phosphate plot ..	43 lbs.
To kainit plot ..	110 lbs.
To acid phosphate and kainit plot ..	123 lbs.

---

**Average increase with cotton seed meal..... 117 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..	176 lbs.
To cotton seed meal plot ..	27 lbs.
To kainit plot ..	145 lbs.
To cotton seed meal and kainit plot ..	158 lbs.

---

**Average increase with acid phosphate. .... 127 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ..	20 lbs.
To cotton seed meal plot ..	—62 lbs.
To acid phosphate plot ..	—11 lbs.
To cotton seed meal and acid phosphate plot ....	69 lbs.

---

**Average increase with kainit..... 4 lbs.**

*Tuscaloosa, Hugent, Vick and Notasulga experiments with cotton.*

Plot No.	Amount per acre.	FERTILIZERS.	TUSCALOOSA. 1900.			HUGENT. 1899.			VICK. 1899.			VICK. 1900.			NOTASULGA. 1899.		
			Yield seed cotton per acre.	Increase over unfertilized plots	Lbs.	Yield seed cotton per acre.	Increase over unfertilized plots	Lbs.	Yield seed cotton per acre.	Increase over unfertilized plots	Lbs.	Yield seed cotton per acre.	Increase over unfertilized plots	Lbs.	Yield seed cotton per acre.	Increase over unfertilized plots	Lbs.
1	200	Cotton seed meal	680	216	680	484	128	992	268	526	62	192	192	192	192	192	192
2	240	Acid phosphate	616	152	616	798	400	840	104	488	24	576	176	576	176	176	176
3	00	No fertilizer	464	...	464	338	...	738	...	464	...	400	...	400	...	...	...
4	200	Kainit.	496	26	496	400	72	688	-24	452	-1	544	20	544	20	20	20
5	200	Cotton seed meal	984	508	984	880	580	848	200	544	101	724	219	724	219	219	219
6	240	Acid phosphate	788	285	788	560	248	824	220	532	99	616	180	616	180	180	180
7	200	Kainit.	704	25	704	672	368	652	92	500	77	682	165	682	165	165	165
8	200	Acid phosphate	496	...	496	296	...	516	...	412	...	448	...	448	...	...	...
9	200	No fertilizer	1240	744	1240	872	576	700	184	504	92	786	288	786	288	288	288
10	240	Acid phosphate	1040	544	1040	752	456	840	324	496	84	744	296	744	296	296	296



AUBURN EXPERIMENTS IN 1898, 1899, & 1900, ON EXPERIMENT STATION FARM.

These tests were made on three adjacent areas set apart for permanent fertilizer experiments with cotton, corn, and oats. The soil is of the same character on all three areas, as was also the previous fertilization of each plot.

All three of the cotton crops were preceded by oats fertilized like the corresponding cotton plot.

In 1900 each plot received the same fertilizer as in 1898 and 1899. Hence the results should show not only the immediate effects of fertilizers, but the residual on cumulative effects, if there are any on this light soil.

Contrary to our usual custom, cowpeas were not sown after the oats, but instead a thin growth of crabgrass, rag weed, and poverty weed covered the ground during the summer and fall following the harvesting of each oat crop.

Commercial fertilizers, chiefly acid phosphate, had been liberally, though not lavishly, employed annually for a number of years before the experiment began.

The soil is a deep sand bed nearly free from stone or gravel, and the plots occupy the crest of a hill.

The dates of planting were April 15, 1898; April 11, 1899; and April 24, 1900. The stand was nearly perfect except in 1900, when there was some slight want of uniformity, so that the figures for 1900 represent the yields after being corrected on the basis of an equal number of plants on each plot.

The Peerless variety was used each year. In 1898 black rust was quite injurious. September 23 it was estimated that the plants on the plots on which kainit had been used had shed 50 to 70 per cent. of their leaves while

the plants receiving no kainit had shed 75 to 92 per cent of their leaves.

The prevalence of black rust probably accounts, at least in part, for the very favorable showing made by kainit in 1898, for numerous experiments recorded in the bulletins of this Station show that kainit generally decreases the injury from black rust.

*Fertilizer experiments with cotton at Auburn, 1898, 1899 and 1900 on Experiment Station farm.*

Plot No.	Amount per acre.	FERTILIZERS.  KIND.	1898.		1899.		1900.		Average increase 8 years.
			Yield.	Increase.	Yield.	Increase.	Yield.	Increase.	
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal.....	889	214	1008	234	379	35	181
2	240	Acid phosphate.....	853	178	819	145	268	-78	82
3	00	No fertilizer.....	875	..	774	..	844	..	..
4	200	Kainit.....	783	122	1049	262	860	46	143
5	200	Cotton seed meal.....	1013	346	1029	231	393	109	229
	240	Acid phosphate.....							
6	200	Cotton seed meal.....	1192	529	1075	265	434	180	325
	200	Kainit.....							
7	240	Acid phosphate.....	1145	486	1051	229	246	22	246
	200	Kainit.....							
8	00	No fertilizer.....	855	..	833	..	194	..	..
	200	Cotton seed meal.....							
9	240	Acid phosphate.....	1177	522	1152	319	435	241	361
	200	Kainit.....							
10	200	Cotton seed meal.....			1055	422			
	240	Acid phosphate.....							
	100	Kainit.....							

*Increase in yield from cotton seed, acid phosphate, and kainit  
on Experiment Station Farm in 1898, 1899 and 1900.*

	Increase; lbs. seed cotton per acre.			
	1898	1899	1900.	Average, 3 years.
<i>Increase of seed cotton per acre where cotton seed meal was added</i>				
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
To unfertilized plot.....	214	234	35	161
To acid phosphate plot.....	168	86	187	147
To kainit plot.....	407	8	134	181
To acid phosphate and kainit plot .....	36	90	219	115
<b>Average increase with cotton seed meal.</b>	<b>206</b>	<b>103</b>	<b>144</b>	<b>151</b>
<i>Increase of seed cotton per acre where phos- phate was added</i>				
To unfertilized plot.....	178	145	-78	82
To cotton seed meal plot .....	132	-3	194	80
To kainit plot.....	364	-33	-24	102
To cotton seed meal and kainit plot.....	-7	54	61	36
<b>Average increase with acid phosphate...</b>	<b>167</b>	<b>41</b>	<b>38</b>	<b>82</b>
<i>Increase of seed cotton per acre where kainit was add-d</i>				
To unfertilized plot.....	122	262	46	143
To cotton seed meal plot.....	315	31	145	164
To acid phosphate plot .....	308	84	100	164
To cotton seed meal and acid phos. plot..	176	58	132	132
<b>Average increase with kainit.....</b>	<b>235</b>	<b>116</b>	<b>108</b>	<b>152</b>

In 1898 the greatest increase in yield was obtained by the use of a mixture of cotton seed meal and kainit. This mixture was a close second to the complete fertilizer in 1899 and 1900 and its average increase for the three years lacked only 36 pounds of seed cotton per acre of equalling the increase due to a complete fertilizer.

Quite unexpectedly, acid phosphate has not been very effective. If this is due to the accumulation of a sufficient supply of phosphoric acid in the soil from the phosphate applied annually for many years before the

beginning of the experiment, the value of applications of phosphate should become more marked in future as this supply is exhausted.

It would be safe to estimate the amount of phosphate applied annually during the decade before the test began at 200 pounds per acre or less. Results on most soils seem to indicate that phosphate is the most important single fertilizing material for cotton.

EXPERIMENTS CONDUCTED BY J. D. FOSTER, 1 MILE SOUTH  
OF AUBURN, LEE COUNTY.

*Light sandy loam, gray upland; subsoil yellowish clay  
or loam, not compact.*

The experiments of 1899 and 1900 were conducted in different parts of the same field, on identical soil.

The field, on which the original growth was reported as long-leaf pine, had been in cultivation for a great many years.

The crop preceding the experiment of 1899 was corn, with drilled cowpeas between the rows. The peas made only a moderate growth and were grazed in the fall of 1898.

The stand of cotton was uniform. In 1900 cotton was planted May 25. The cotton experiment in 1900 occupied the plots that had been used in 1899 for a similar fertilizer experiment with corn, (having no cowpeas between the rows.) Hence the results of the cotton experiment of 1900 should show not only the immediate effects of each fertilizer, but also the residual or second-year effects, if there were any lasting benefit from commercial fertilizers used on this light soil.

*Auburn experiment with cotton on J. D. Foster farm.*

Plot No.	FERTILIZERS.		1899.		1900.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal .....	616	280	600	240
2	240	Acid phosphate .....	528	192	488	128
3	00	No fertilizer .....	336	.....	360	.....
4	200	Kainit .....	520	183	432	79
5	200	Cotton seed meal .....	744	405	744	397
	240	Acid phosphate .....				
6	200	Cotton seed meal .....	648	307	688	347
	200	Kainit .....				
7	240	Acid phosphate .....	568	225	528	194
	200	Kainit .....				
8	00	No fertilizer .....	344	.....	328	.....
	200	Cotton seed meal .....	664	320	726	398
9	240	Acid phosphate .....				
	200	Kainit .....				
	200	Cotton seed meal .....	656	312	688	360
10	240	Acid phosphate .....				
	100	Kainit .....				

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot ..	280 lbs.	240 lbs.
To acid phosphate plot ..	213 lbs.	269 lbs.
To kainit plot ..	124 lbs.	268 lbs.
To acid phosphate and kainit plot....	95 lbs.	204 lbs.

**Average increase with cotton seed meal, 178 lbs. 245 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..	192 lbs.	128 lbs.
To cotton seed meal plot ..	125 lbs.	157 lbs.
To kainit plot ..	42 lbs.	115 lbs.
To cotton seed meal and kainit plot ..	13 lbs.	51 lbs.

**Average increase with acid phosphate, 93 lbs. 113 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. . . . . .	183 lbs.	79 lbs.
To cotton seed meal plot .. . . . . .	27 lbs.	107 lbs.
To acid phosphate plot .. . . . . .	33 lbs.	66 lbs.
To cotton seed meal and acid phosphate plot .. . . . . .	—85 lbs.	1 lb.
<b>Average increase with kainit. . . . .</b>	<b>39 lbs.</b>	<b>63 lbs.</b>

The figures for the two years agree closely and show that a larger increase was afforded by cotton seed meal than by any other single material. The most profitable of all the fertilizers was a mixture of cotton seed meal and phosphate. Kainit was unprofitable.

EXPERIMENT CONDUCTED BY JUDGE T. J. THOMASON, 2  
MILES SOUTH OF RANBURN (NEAR KAYLOR),  
RANDOLPH COUNTY.

This experiment was made in 1899 on gray land, with yellow subsoil. The soil is described as table land rather retentive of moisture. The preceding crop was cotton.

This is the third experiment on a uniform plan conducted by Judge Thomason. (See Bulletin No. 107; p. 274). If we take the average increase of each fertilizer under all conditions we have for the entire period of three years an average increase of 187 pounds of seed cotton per acre attributable to cotton seed meal, 197 to phosphate, and only 31 to kainit. The inference is plain that a mixture of cotton seed meal and phosphate was all that cotton needed on this soil, and that the addition of kainit, at the rate of 200 pounds per acre, was usually unprofitable. The results for 1899, when kainit afforded a slight profit, were more favorable to potash than were the results of the two previous tests on this soil.

The following statements show the average increase in yield for the entire period of three years.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .. .	217 lbs.
To acid phosphate plot .. .	137 lbs.
To kainit plot .. .	156 lbs.
To acid phosphate and kainit plot.....	238 lbs.

---

**Average increase with cotton seed meal..... 187 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .. .	264 lbs.
To cotton seed meal plot .. .	184 lbs.
To kainit plot .. .	128 lbs.
To cotton seed meal and kainit plot .. .	210 lbs.

---

**Average increase with acid phosphate..... 197 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. .	90 lbs.
To cotton seed meal plot .. .	29 lbs.
To acid phosphate plot .. .	—80 lbs.
To acid phosphate and cotton seed meal.....	54 lbs.

---

**Average increase with kainit..... 31 lbs.**

EXPERIMENT CONDUCTED BY T. T. MEADOWS  $\frac{1}{2}$  MILE  
NORTH OF CUSSETA, CHAMBERS COUNTY.

*Soil, red, stoney; subsoil red clay.*

This test, made in 1899, is the third experiment conducted on similar soil by Mr. Meadows. (See Bulletin No. 107, p. 274.)

Giving attention to the average results for the three years we find that the principal need of this soil was for

acid phosphate, which gave an average increase of 202 pounds of seed cotton per acre. Cotton seed meal was added to the phosphate with profit, but kainit was not needed.

The red clay soils of the Metamorphic Region in this part of the State seem to contain sufficient potash for the ordinary needs of the cotton crop, though when black rust is prevalent kainit is beneficial even here.

Statements of the average increase in yield for the *three years* follows:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ..	109 lbs.
To acid phosphate plot ..	156 lbs.
To kainit plot ..	164 lbs.
To acid phosphate and kainit plot ..	128 lbs.

**Average Increase with cotton seed meal..... 139 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..	192 lbs.
To cotton seed meal plot ..	239 lbs.
To kainit plot ..	217 lbs.
To cotton seed meal and kainit plot.....	189 lbs.

**Average increase with acid phosphate..... 202 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ..	—8 lbs.
To cotton seed meal plot ..	43 lbs.
To acid phosphate plot ..	15 lbs.
To cotton seed meal and acid phosphate plot....	—9 lbs.

**Average increase with kainit..... 10 lbs.**



**EXPERIMENT CONDUCTED IN 1900 BY W. N. INGRAM, 8  
MILES EAST OF OPELIKA, LEE COUNTY.**

The description of the land seems to indicate that the soil was a yellowish loam, with subsoil of somewhat the same character, and not compact. The original growth is reported as oak and hickory, which had been removed about forty years before. The rainfall was excessive in June. The preceding crop was corn.

The results are not entirely conclusive, but on the whole they show that cotton seed meal was profitable and that the returns from the other fertilizers this wet year were not satisfactory.

**Increase of seed cotton per acre when cotton seed meal was added:**

**added:**

To unfertilized plot ..	248 lbs.
To acid phosphate plot ..	—30 lbs.
To kainit plot ..	242 lbs.
To acid phosphate and kainit plot ..	180 lbs.

**Average increase with cotton seed meal .....** 160 lbs.

**Increase of seed cotton per acre when acid phosphate was added:**

To unfertilized plot ..	96 lbs.
To cotton seed meal plot ..	—182 lbs.
To kainit plot ..	87 lbs.
To cotton seed meal and kainit plot.....	25 lbs.

**Average increase with acid phosphate .....** 7 lbs.

**Increase of seed cotton per acre when kainit was added:**

To unfertilized plot ..	29 lbs.
To cotton seed meal plot ..	23 lbs.
To acid phosphate plot ..	20 lbs.
To cotton seed meal and acid phosphate plot....	230 lbs.

**Average increase with kainit .....** 75 lbs.

*Kaylor, Cusseta and Opelika experiments with cotton.*

Plot No.	FERTILIZERS.		KAYLOR. 1899.		CUSSETA. 1899		OPELIKA. 1900.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
1	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal...	888	112	298	104	1000	248
2	240	Acid phosphate....	848	72	456	284	848	96
3	00	No fertilizer.....	776	.....	192	..	752	.....
4	200	Kainit.....	804	49	152	--45	800	29
5	200	Cotton seed meal.	1084	350	504	302	856	66
	240	Acid phosphate....						
6	200	Cotton seed meal.	944	232	304	97	1060	271
	200	Kainit.....						
7	240	Acid phosphate....	872	182	472	280	944	116
	200	Kainit.....						
8	00	No fertilizer.....	668	.....	216	.....	848	.....
9	200	Cotton seed meal.	1124	456	640	424	1144	296
	240	Acid phosphate....						
10	200	Cotton seed meal.	1140	472	560	344	1112	284
	240	Acid phosphate....						
	100	Kainit.....						

**EXPERIMENT CONDUCTED BY J. C. WATKINS  $1\frac{1}{2}$  MILES NORTH OF BURNT CORN, MONROE COUNTY.**

The experiments of 1899 and 1900 were made on poor yellowish or chocolate-colored upland sandy soil, with red subsoil. This soil bakes badly.

The rainfall in 1900 was excessive. There was no black rust in either year.

The table on page 34 gives the yields for 1899 and 1900. This is the fourth experiment made by Mr. Watkins according to the present plan. (See Bulletin No. 197, p. 274). Most of the tests have shown that phosphate was more important than cotton seed meal and that kainit only increased the yield; however in 1900 kainit was the most effective fertilizer.

The average results for 4 years show that phosphate gave an average increase of 207, cotton seed meal of 151, and kainit of 70 pounds of seed cotton per acre.

*Burnt Corn experiments with cotton.*

Plot No.	FERTILIZERS.		1899.		1900.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal.....	480	216	348	— 60
2	240	Acid phosphate .....	556	292	456	48
3	00	No fertilizer .....	264	.....	408	.....
4	200	Kainit.....	280	27	528	128
5	200	Cotton seed meal.....	788	528	492	100
5	240	Acid phosphate .....				
6	200	Cotton seed meal.....	524	293	588	204
6	200	Kainit .....				
7	240	Acid phosphate.....	684	465	476	100
7	200	Kainit .....				
8	00	No fertilizer .....	208	.....	368	.....
9	200	Cotton seed meal. ....				
9	240	Acid phosphate .....	828	620	648	280
9	200	Kainit.....				
10	200	Cotton seed meal.....				
10	240	Acid phosphate .....	944	736	532	164
10	100	Kainit .....				

The following figures refer only to the results obtained in 1900, similar statement for other years having been previously published:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....—60 lbs.

To acid phosphate plot ..... 52 lbs.

To kainit plot ..... 76 lbs.

To acid phosphate and kainit plot .....180 lbs.

**Average increase with cotton seed meal..... 62 lbs.**

→Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	48 lbs.
To cotton seed meal plot .....	160 lbs.
To kainit plot .....	—28 lbs.
To cotton seed meal and kainit plot .....	76 lbs.

**Average increase with acid phosphate ..... 64 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	128 lbs.
To cotton seed meal plot .....	264 lbs.
To acid phosphate plot .....	52 lbs.
To cotton seed meal and acid phosphate plot....	180 lbs.

**Average increase with kainit..... 155 lbs.**

EXPERIMENT MADE BY C. E. RIVERS, 6½ MILES S. OF  
HURTSBORO, RUSSELL COUNTY.

*Dark sandy soil, with yellow subsoil.*

This test was made in 1900 on flat land that might be designated as second bottom.

The land had been cleared about 40 years ago of its original growth of long leaf pine, but for many years before the experiment began it had been uncultivated and had grown up in broomsedge. The date of planting was late and it was noted that many bolls, especially on Plots 9 and 10, did not mature.

Phosphate under all conditions was highly profitable. The average increase with cotton meal was not quite sufficient to yield a profit; this poor showing of cotton seed meal is probably due to the fact that considerable vegetable matter and nitrogen must have accumulated on the land while it was uncultivated. On fields in

constant cultivation some cotton seed meal would doubtless have been profitable. Kainit was slightly helpful and as a part of a complete fertilizer, containing all three materials, kainit paid a fair profit.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	154 lbs.
To acid phosphate plot .....	30 lbs.
To kainit plot .....	14 lbs.
To acid phosphate and kainit plot .....	27 lbs.

**Average increase with cotton seed meal..... 56 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	240 lbs.
To cotton seed meal plot .....	116 lbs.
To kainit plot .....	274 lbs.
To cotton seed meal and kainit plot .....	287 lbs.

**Average increase with acid phosphate..... 229 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	83 lbs.
To cotton seed meal plot .....	—57 lbs.
To acid phosphate plot .....	117 lbs.
To cotton seed meal and acid phosphate plot....	114 lbs.

**Average increase with kainit..... 64 lbs.**

EXPERIMENT MADE IN 1899 BY A. M. TROYER,  $\frac{3}{4}$  OF A MILE  
N. OF CALHOUN, LOWNDES COUNTY.

The soil is described as a loam fairly retentive of water and as being of a very light reddish color, with bright red subsoil. The second growth of trees, removed about 5 years ago, was short leaf and old field pine. In 1896

and 1897 this field was not cultivated, and in 1898 the crop was oats.

Under all conditions acid phosphate was highly profitable, the average increase attributable to phosphate being 434 pounds per acre. Cotton seed meal was generally profitable, but not to the same extent as phosphate. Kainit was not needed. By far the larger profit was obtained on the plot containing both acid phosphate and cotton seed meal.

Mr. Troyer also conducted an experiment in 1900 on similar soil, the results of which were entirely inconclusive. They may be found in the table on page 52.

In 1900 he also tested the most promising combinations of fertilizers on an adjoining farm, on very sandy soil.

The fertilizer for this last test was not furnished by the Experiment Station and a detailed report of the amounts of fertilizer used is not at hand.

The following is Mr. Troyer's statement of the increase in yield in 1900 on his sandy soil, where the unfertilized land yielded 384 pounds of seed cotton per acre:

Increase per acre in		
	lbs. seed cotton.	Net profit.
Cotton seed meal .....	144	\$2.40
Acid phosphate ..	48	.16
Kainit ..	112	2.88
Cotton seed meal and phosphate...	176	1.76
Cotton seed meal, phosphate and kainit ..	320	5.28

Apparently on this sandier soil a complete fertilizer was needed, kainit, as well as other materials, yielding a profit.

The increased yields obtained in the experiment at Calhoun in 1899 are given below:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ..	312 lbs.
To acid phosphate plot .....	267 lbs.
To kainit plot .....	187 lbs.
To acid phosphate and kainit plot .....	—138 lbs.

**Average increase with cotton seed meal..... 157 lbs.**

Increase of seed cotton per acre when acid phosphate was added.

To unfertilized plot ..	482 lbs.
To cotton seed meal plot ..	437 lbs.
To kainit plot .....	571 lbs.
To cotton seed meal and kainit plot .....	246 lbs.

**Average increase with acid phosphate..... 434 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	107 lbs.
To cotton seed meal plot .....	—18 lbs.
To acid phosphate plot ..	196 lbs.
To cotton seed meal and acid phosphate plot..	—209 lbs.

**Average increase with kainit..... 19 lbs.**

EXPERIMENT MADE BY W. C. BEVILL IN 1899 NEAR NAHEOLA, CHOCTAW COUNTY.

This experiment was made on upland soil of a "dark mulatto" color, with red clay subsoil. The three preceding crops were cotton. The field had been cleared about 50 years and the original growth is reported as long leaf pine, short leaf pine, oak, and gum.

There was no rust or other injury except from severe

drought, which reduced the yield to about half a crop, and which probably makes the experiment nearly valueless as an indication of the needs of the cotton plant on this soil in normal seasons.

Under the conditions of this test no fertilizer was very effective, though the increase with cotton seed meal was sufficient to pay a small profit.

Mr. Bevill conducted an experiment in 1898 on what appeared to be similar soil. In that year cotton seed meal gave a large increase in yield, phosphate a smaller though profitable increment, and kainit an increase barely sufficient to afford a small profit. In 1898 as well as in 1899 unfavorable weather vitiated the experiment, and it is doubtful whether the results for either year show the full effect that any of the three fertilizers would exert in normal seasons.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	56 lbs.
To acid phosphate plot .....	178 lbs.
To kainit plot .....	114 lbs.
To acid phosphate and kainit plot .....	172 lbs.

---

**Average increase with cotton seed meal..... 130 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	32 lbs.
To cotton seed meal plot .....	154 lbs.
To kainit plot .....	—25 lbs.
To cotton seed meal and kainit plot .....	33 lbs.

---

**Average increase with acid phosphate ..... 49 lbs.**



Increase of seed cotton per acre when kainit was added:

To unfertilized plot .. . . . . .	13 lbs.
To cotton seed meal plot .. . . . . .	71 lbs.
To acid phosphate plot .. . . . . .	—44 lbs.
To cotton seed meal and acid phosphate plot...—	50 lbs.
<b>Average increase with kainit.....</b>	<b>—3 lbs.</b>

EXPERIMENT MADE ON THE FARM OF THE SOUTH EAST  
ALABAMA AGRICULTURAL SCHOOL, JACK-  
SON, CLARKE COUNTY.

*Stiff, dark red, or "mulatto" soil; subsoil, red clay.*

The experiment of 1899 was conducted by J. L. Ballard, that of 1900 by Prof. J. W. Culver. The field consisted of upland, cleared at least 10 years before the experiment began of its growth of long leaf and short leaf pine and oak. The land used for the experiment of 1900 had ben pastured for two years. No report was made of crops preceding the experiment of 1900.

The results of the two experiments may be found in the table on page 42 and in the analysis of that table given below.

In 1899 phosphate was by far the most effective fertilizer, though both cotton seed meal and kainit, as well as phosphate, were profitable when employed in a complete fertilizer.

In 1900, on ground not fertilized for several years previous to the experiment, all three fertilizing materials were exceedingly effective, all being of practically equal importance. This soil is unusually responsive to commercial fertilizers. A complete fertilizer afforded much the largest profit, both in 1899 and 1900.

Increase of seed cotton per acre when seed meal was added:

	1899.	1900.
To unfertilized plot .....	136 lbs.	112 lbs.
To acid phosphate plot .....	—90 lbs.	179 lbs.
To kainit plot .....	—146 lbs.	356 lbs.
To acid phosphate and kainit plot ..	500 lbs.	855 lbs.

**Average increase with cotton seed meal, 103 lbs. 376 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	336 lbs.	176 lbs.
To cotton seed meal plot .....	110 lbs.	243 lbs.
To kainit plot .....	—7 lbs.	234 lbs.
To cotton seed meal and kainit plot...	639 lbs.	733 lbs.

**Average increase with acid phosphate, 269 lbs. 347 lbs.**

Increase of seed cotton per acre when kainit was used:

To unfertilized plot .....	115 lbs.	79 lbs.
To cotton seed meal plot .....	—167 lbs.	323 lbs.
To acid phosphate plot .....	—228 lbs.	137 lbs.
To cotton seed meal and acid phosphate plot ..	362 lbs.	813 lbs.

**Average increase with kainit..... 21 lbs. 334 lbs.**

Several experiments had been made previously on this farm. That of 1898 showed acid phosphate to be the most valuable single fertilizer, but that both kainit and cotton seed meal afforded such an increase as to make the complete fertilizer—which contained all three—the most profitable of all applications.

In 1897, when drought prevailed, only cotton seed meal was very effective.

Clearly a complete fertilizer is profitable on this soil, which lends itself readily to intensive farming.

*Hurtsboro, Calhoun, Nahaola and Jackson experiments with cotton.*

Plot No.	FERTILIZERS.		HURTSBORO. 1900.		CALHOUN. 1899.		NAHAOLA. 1899.		JACKSON. 1899.		JACKSON. 1900.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	512	154	536	58	58	960	136	552	112	112
2	240	Acid phosphate	688	240	718*	32	32	1160	838	616	176	176
3	00	No fertilizer	368	...	236*	...	480	824	...	440	...	...
4	200	Kainit	440	83	368	107	520	968	115	520	79	79
5	200	Cotton seed meal	616	270	1080	749	744	310	1128	246	808	355
6	240	Acid phosphate	432	97	598	294	698	127	880	—31	880	435
7	200	Cotton seed meal	680	357	504	678	578	—12	1048	108	780	313
8	240	Acid phosphate	312	...	850	...	616	...	968	...	448	...
9	00	No fertilizer	606	...	880	540	776	180	1576	608	1616	1168
10	200	Cotton seed meal	720	408	780*	430*	800	184	1440	472	1520	1072
	240	Acid phosphate										
	100	Kainit										

\* Defective stand.

EXPERIMENTS MADE BY G. S. McCLURE, 2 MILES EAST OF  
GARLAND, BUTLER COUNTY.

*Gray sandy land, with stiffer yellowish subsoil at depth  
of 6 inches.*

The experiment in 1899 was made in a field cleared about 1880 and continuously in cultivation during each of the past six years. The test in 1900 was conducted on land that had been cleared about twelve years. The original growth was long-leaf pine, with a few black-jack oaks.

In both experiments oats was the preceding crop. There was practically no injury from "black rust" in 1900. In 1899 this disease caused considerable loss on Plot 2 and a smaller amount on plots 5 and 3, with practically no injury on other parts of the experiment.

The table on page 48 and the analysis of that table given below show the yield and amount of increase attributable to the fertilizers.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot . . . . .	272 lbs.	96 lbs.
To acid phosphate plot . . . . .	492 lbs.	336 lbs.
To kainit plot . . . . .	252 lbs.	168 lbs.
To acid phosphate and kainit plot . . . .	40 lbs.	344 lbs.
<b>Average increase with cotton seed meal,</b>	<b>264 lbs.</b>	<b>236 lbs.</b>

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot . . . . .	152 lbs.	160 lbs.
To cotton seed meal plot . . . . .	372 lbs.	400 lbs.
To cotton seed meal and kainit plot . . . .	154 lbs.	208 lbs.
<b>Average increase with acid phosphate,</b>	<b>261 lbs.</b>	<b>200 lbs.</b>

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	226 lbs.	48 lbs.
To cotton seed meal plot .....	206 lbs.	120 lbs.
To acid phosphate plot .....	440 lbs.	—80 lbs.
To cotton seed meal and acid phosphate plot .....	—12 lbs.	—72 lbs.

**Average increase with kainit..... 216 lbs. —4 lbs.**

In both years the most profitable fertilizer was a mixture of acid phosphate and cotton seed meal. Both cotton seed meal and acid phosphate, whether applied alone, or in combination, were highly profitable. Kainit had no beneficial effect in the presence of a mixture of phosphate and cotton seed meal, but in 1899, kainit was quite effective when used alone or in combination with either one (but not both) of the other materials; this was the season when rust was injurious on certain plots receiving no kainit.

Two experiments made in the same region by G. O. Sellans, at Lumber Mills, (see Bulletin No. 102) accord with Mr. McClure's experiments in showing that these soils are highly responsive to acid phosphate and cotton seed meal and that kainit is decidedly beneficial only in seasons when black rust is severe.

EXPERIMENT MADE IN 1899 BY C. H. MASON,  $\frac{1}{2}$  MILE N. OF  
WILSON, ESCAMBIA COUNTY.

*Light sandy loam; with red clay subsoil.*

This field of upland was cleared of its growth of long-leaf pine two years before the beginning of the test and during these two years the land was occupied by cow-peas, presumably grown for hay.

For yields of cotton seed see the table on page 48.

The following analysis shows that the one conspicuous need of this fresh land was for phosphate. The indifference of this particular field towards cotton seed meal is due to the recent clearing and to the two preceding crops of peas, both of which conditions imply the presence of considerable nitrogen in the soil. The soils of this region after a few years cultivation usually respond profitably to both phosphate and cotton seed meal, and some of them to kainit. A test made at Wilson on "new ground" in 1898 by J. H. Wilcox, gave results similar to those obtained in this experiment.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	200 lbs.
To acid phosphate plot .....	—112 lbs.
To kainit plot .....	24 lbs.
To acid phosphate and kainit plot .....	208 lbs.

**Average increase with cotton seed meal..... 108 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	632 lbs.
To cotton seed meal plot .....	320 lbs.
To kainit plot .....	328 lbs.
To cotton seed meal and kainit plot .....	512 lbs.

**Average increase with acid phosphate..... 448 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	8 lbs.
To cotton seed meal plot .....	—168 lbs.
To acid phosphate plot .....	—292 lbs.
To cotton seed meal and acid phosphate plot....	24 lbs.

**Average decrease with kainit..... 107 lbs.**

EXPERIMENTS MADE IN 1899 AND 1900 BY T. M. BORLAND,  
 $\frac{1}{2}$  MILE S. W. OF DOTHAN, HENRY COUNTY.

*Gray sandy land; subsoil yellowish.*

The land was cleared of the original growth of long leaf pine nearly 10 years ago. In both cases the preceding crop was corn. Mr. Borland writes that peanuts were grown in 1899 between the corn rows on the area where the cotton experiment of 1900 was conducted.

Very hot dry weather in the latter part of the summer of 1899, and lice and excessive rainfall in 1900 damaged the crop. The experimenter reports that rust was absent.

Increase of seed cotton per acre when cotton seed meal was added:

	1899.	1900.
To unfertilized plot . . . . .	248 lbs.	56 lbs.
To acid phosphate plot . . . . .	110 lbs.	20 lbs.
To kainit plot . . . . .	119 lbs.	93 lbs.
To acid phosphate and kainit plot. . . . .	123 lbs.	81 lbs.

**Average increase with cotton seed meal, 150 lbs. 63 lbs.**

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot . . . . .	208 lbs.	208 lbs.
To cotton seed meal plot . . . . .	70 lbs.	172 lbs.
To kainit plot . . . . .	227 lbs.	30 lbs.
To cotton seed meal and kainit plot. . . . .	231 lbs.	18 lbs.

**Average increase with acid phosphate, 184 lbs. 107 lbs.**

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	106 lbs.	201 lbs.
To cotton seed meal plot .....	—23 lbs.	238 lbs.
To acid phosphate plot .....	125 lbs.	23 lbs.
To cotton seed meal and acid phosphate plot ..	138 lbs.	84 lbs.

**Average increase with kainit, . . . 87 lbs. 139 lbs.**

In both experiments a complete fertilizer afforded the largest increase in yield. A showing almost as favorable was made by the mixture of cotton seed meal and kainit.

The slight benefit from cotton seed meal in 1900 is probably due to the fact that peanuts were grown between the corn rows the year before. The experiment of 1900 makes the fourth test of fertilizers on cotton made on this farm. All these results point toward the need of all three of the fertilizer materials tested, kainit giving the largest average increase for the four years, viz.: 168 pounds of seed cotton per acre per annum. A similar average shows the increase with cotton seed meal to be 134 pounds, and with phosphate to be 122 pounds.

It is not surprising that this land, which has been in cultivation less than 10 years should be less responsive to cotton seed meal than are most of the soils of regions that were settled earlier. It also seems less responsive to phosphate and more so to kainit than do most of the soils on which tests have been made.



*Garland, Wilson and Dothan experiments with cotton.*

Plot No.	FERTILIZERS.		GARLAND. 1899.		GARLAND. 1900.		WILSON. 1898.		DOTHAN. 1899.		DOTHAN. 1900.	
	Amount per acre.	Kind.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal.....	684	272	504	96	280	200	840	248	424	56
2	240	Acid phosphate.....	544	152	588	160	712	632	800	208	576	208
3	00	No fertilizer.....	392	.....	408	.....	80	.....	592	.....	388	.....
4	200	Kainit.....	640	228	448	48	88	8	696	108	552	201
5	200	Cotton seed meal.....	1080	644	588	408	600	520	901	318	580	228
6	240	Acid phosphate.....	936	478	600	216	112	82	808	225	608	284
7	200	Kainit.....	1072	592	456	80	416	886	912	388	528	281
8	00	No fertilizer.....	512	.....	388	.....	80	.....	576	.....	280	.....
9	200	Cotton seed meal.....	1144	632	792	424	624	544	1082	456	692	812
10	240	Acid phosphate.....	1176	684	736	358	728	648	920	844	472	192
	100	Kainit.....										

## INCONCLUSIVE EXPERIMENTS.

The three following tables give the yields obtained in tests that were altogether inconclusive:

The list on page 3 gives the names of the parties making the experiments at each of the localities referred to in the three tables that follow. In the case of some of these tests suggestions of value may reward a careful examination of the figures, but usually want of uniformity in the soil selected, or other vitiating condition, entirely destroys the worth of the experiments here tabulated.

*Tuscumbia, Boligee, Berney and Hamilton experiments with cotton.*

Plot No.	FERTILIZERS.	BOLIGEE. 1899.		BERNEY'S. 1899.		BERNEY'S. 1900.		HAMILTON. 1900.		TUSCUMBIA. 1899.		TUSCUMBIA. 1900.	
		Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
	Kind.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200 Cotton seed meal.....	832	298	988	72	589	40	582	136	752	184	600	240
2	240 Acid phosphate.....	610	104	384	72	552	24	600	184	728	160	596	176
3	00 No fertilizer.....	536	...	246	...	528	...	416	...	568	...	860	...
4	200 Kainit.....	512	-16	418	155	575	49	568	125	784	252	296	-24
5	200 Cotton seed meal.....	640	120	418	200	988	443	680	210	568	71	312	90
6	240 Acid phosphate.....	632	120	480	197	704	181	668	171	410	-22	272	28
7	200 Cotton seed meal.....	528	24	580	283	760	289	808	283	456	28	264	60
8	200 Kainit.....	496	...	272	...	520	...	552	...	392	...	168	...
9	200 No fertilizer.....	418	-48	461	192	624	104	508	256	352	-40	480	312
10	200 Acid phosphate.....	278	-208	432	100	560	40	818	266	544	152	432	264
	240 Cotton seed meal.....												
	200 Kainit.....												
	240 Acid phosphate.....												
	100 Kainit.....												

## Sterrett, Dillburg, Marvyn, Oak Bowery and Greensboro experiments with cotton.

Plot No.	FERTILIZERS.		STERRETT. 1899.		STERRETT. 1900.		DILLBURG. 1900.		MARVYN. 1899.		OAK BOWERY. 1900.		GREENSBORO. 1899.	
	Amount per acre.	KIND.	Yield seed cotton per acre.	Increase over unfertilized plots	Yield seed cotton per acre.	Increase over unfertilized plots	Yield seed cotton per acre.	Increase over unfertilized plots	Yield cotton seed per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
1	lbs.	Cotton seed meal.....	752	328	lbs.	328	lbs.	508	lbs.	376	lbs.	120	lbs.	362
2	200	Acid phosphate.....	640	216	—184	16	576	508	—16	00	240	00	584	168
3	240	No fertilizer.....	424	.....	1128	.....	872	504	.....	.....	280	.....	416	.....
4	200	Kainit.....	528	82	1120	00	568	200	472	170	868	95	576	108
5	200	Cotton seed meal.....	744	275	1128	189	816	448	400	75	864	117	688	285
6	240	Acid phosphate.....	712	221	1056	218	816	448	432	85	416	116	720	328
7	200	Cotton seed meal.....	780	246	840	93	656	288	360	—10	408	154	504	114
8	240	Acid phosphate.....	536	.....	656	.....	368	.....	392	.....	248	.....	284	.....
9	200	No fertilizer.....	768	282	936	280	816	488	584	192	400	152	520	136
10	200	Cotton seed meal.....	760	224	912	256	680	312	685	296	240	—8	536	152
	240	Acid phosphate.....												
	100	Kainit.....												

*Calhoun, Greenville, Evergreen, Union Springs and Abbeville experiments with cotton.*

Plot No.	FERTILIZERS.	CALHOUN. 1900.		GREENVILLE 1900.		EVERGREEN. 1899.		UNION SPRINGS. 1899		ABBEVILLE. 1899.		ABBEVILLE. 1900.	
		Yield seed cotton per acre.	Increase over unfertilized plots	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.	Yield seed cotton per acre.	Increase over unfertilized plots.
Amount per acre.	KIND.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	Cotton seed meal.....	444	80	1018	583	882	270	578	152	780	320	278	152
2	Acid phosphate.....	310	—64	968	520	764	152	444	20	636	216	184	40
3	No fertilizer.....	364				612		424		410		141	
4	Kainit.....	408	—7	960	5.2	808	196			552	137	205	27
5	Cotton seed meal.....	256	—210	1144	693	840	228	912	376	694	274	458	237
6	Acid phosphate.....	640	123	848	400	896	281	496	—96	640	276	462	211
7	Kainit.....	664	96	676	128	1016*	404*	568	—80	416	79	363	71
8	No fertilizer.....	620		448		901*		701		312		336	
9	Cotton seed meal.....	624	4	880	432	1420*	516*	776	72	584	272	608	272
10	Acid phosphate.....	644	24	768	320	1378*	462*	914	240	712	400	568	232
	Kainit.....												

\* Not comparable with Plots 1—6, being in different part of field.



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ALABAMA

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,  
AUBURN.

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## Feeding Experiment with Dairy Cows.

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By J. F. DUGGAR AND R. W. CLARK.

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MONTGOMERY, ALABAMA.  
THE BROWN PRINTING CO.  
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# Feeding Experiments with Dairy Cows.

BY J. F. DUGGAR and R. W. CLARK.

## *Summary.*

With cotton seed at \$8 per ton, cotton seed meal at \$20, cotton seed hulls at \$4, and sorghum hay at \$6.67, butter was produced at a lower cost per pound on a ration consisting chiefly of raw cotton seed and hay than on one made up principally of cotton seed meal and hulls.

The cows did not greatly relish cotton seed and hence ate less than was desirable of the ration containing this; hence on the larger amounts eaten the oil mill ration afforded a larger daily yield of both milk and butter than did the farm-grown ration.

In two experiments the average daily amount of milk per cow was 17.5 pounds from the cotton seed ration and 24.3 pounds from the cotton seed meal ration; the daily production of butter per cow averaged .93 of a pound with the cotton seed and 1.19 with the oil mill ration, this being an increase of 38 per cent in milk and 28 per cent in butter. Nevertheless the low cost of the cotton seed ration made it the more economical, the average cost of the food required to make a pound of butter being only 10.4 cents when this ration was given and 15.3 cents when the hulls and meal ration was employed.

On account of the larger amounts of food consumed, the cows while receiving the cotton seed meal ration gained nearly half a pound a day in weight, while the cows eating cotton seed in smaller amounts lost .8 of a pound per day.



The cheapest butter was made by a Jersey heifer with her first calf, the food to make one pound of butter costing in this case only 6.4 cents when cotton seed was fed and 11.2 cents when cotton seed meal was given.

The manure (liquid and solid) dropped during the 16 hours of each day which the cows passed in the barn was carefully saved, analyzed, and applied to various crops.

The amount of manure, including sawdust bedding, per cow per night (of 16 hours) averaged 33.9 pounds when cotton seed was fed and 48.3 pounds when cotton seed meal was fed.

The manure made from the cotton seed and sorghum hay ration contained 10.7 pounds of nitrogen per ton; that from cotton seed meal and hulls contained 16.6 pounds, an increase of 55 per cent. in the amount of nitrogen per ton.

In percentages of phosphoric acid and potash the two manures were practically identical.

For one or two days the cows were kept stabled during the entire 24 hours and the amount of manure thus obtained (exclusive of bedding) was about double the amount secured by stabling the cows for 16 hours per day.

About one-half the manure was dropped out of doors.

Green rye at the rate of 52 to 54 pounds per day proved a satisfactory substitute for either sorghum hay or cotton seed hulls.

While the cows ate green rye the amount of milk slightly increased but the milk was slightly poorer than during the preceding period when only dry food was consumed.

An upland corn field from which the ears had been harvested, and in which cowpeas had been drilled between the corn rows, was grazed first by milk cows and

later by dry cows, the milk cows meantime receiving 3 pounds of cotton seed meal per day.

On this pasturage the yield of milk was 15.8 per cent greater and of butter 9.5 per cent greater than when the cows with the same grain feed ran on a good pasture of bermuda grass, carpet grass, lespedeza, etc.

The value of the product of butter and of the increase in live weight of the cows averaged \$4.47 per acre of corn and pea field grazed, after deducting the cost of the cotton seed meal fed at the same time.

#### INTRODUCTORY.

Under some conditions it is practicable for the dairyman to purchase a considerable proportion of the food which his cows consume. However, the temptation is to rely to too great an extent on purchased foods. These can be profitably used to a certain extent but rather as supplements to foods produced on the farm than as substitutes for farm-grown food. It is believed that any marked development of dairying and of beef production in the South is conditioned on the increased reliance on the foods which the fields and pastures produce. The feeder who buys thin cattle at a low price and, after a few months feeding, sells them at a higher price per pound, relies almost wholly upon cotton seed meal and hulls, but the stock raiser cannot afford to make the oil mill his principal depot of supplies.

Bearing in mind this necessity for avoiding large expenditures for purchased foods, we have planned a line of experiments intended to ascertain the extent to which farm-grown foods can be relied on in the feeding of dairy cows and the best crops for use as food in effecting this end.

The first experiments here reported are preliminary to this investigation and involve a comparison of a ration

made up chiefly of the most economical of all purchased foodstuffs, cotton seed meal and hulls, with one consisting chiefly of cotton seed and sorghum hay, both of which latter materials can be grown on every farm in the cotton belt.

#### PURCHASED VS. FARM-GROWN RATION IN 1900.

The farm-grown ration consisted of cotton seed and sorghum hay, with small amounts of wheat bran and corn meal added to improve the palatability and to increase the amount of cotton seed consumed. The endeavor was to make each cow eat daily at least 9 pounds raw cotton seed, 10 pounds sorghum hay, 3 pounds wheat bran, and 3 pounds corn meal; and the foods were mixed in these proportions. As much of the mixture was given to each cow as she would eat clean.

The purchased, or "oil mill" ration consisted of a mixture of 5.25 pounds of cotton seed meal, 10 pounds of cotton seed hulls, 3 pounds of wheat bran, and 3 pounds of corn meal. This mixture was also fed in amounts as large as the cows would eat and the quantity consumed was greater than had been expected when the experiment was planned.

The following prices for food stuffs used in calculating the cost of butter are assumed as average prices in this State for a series of years, except that sorghum hay, for which there is no market, is charged at a price somewhat above its average cost of production:

Cotton seed ..	\$ 8.00 per ton.
Cotton seed meal ..	20.00 per ton.
Cotton seed hulls ..	4.00 per ton.
Wheat bran ..	18.00 per ton.
Corn meal ..	20.00 per ton.
Sorghum hay ..	6.67 per ton.

The cows used were as follows:

NAME.	Breed,	Age.	Day since calving.	Weight when test began.
				<i>Lbs.</i>
Ada.....	Jersey.....	8 years..	110	816
Queen.....	Holstein....	8½ years..	81	980
Rozena.....	Holstein....	8½ years..	119	1150
Hypatia.....	Jersey.....	4 years..	19	788
Annie.....	Jersey.....	10 years..	80	762

The experiment was divided into two periods of four weeks each, each period being preceded by a preparatory period of one week during which the cows were accustomed to the food which they were to receive during the next period.

During the first period Ada and Queen received the cotton seed ration, Rozena and Annie meantime getting the ration of cotton seed meal and hulls. During the second period the rations were reversed, so that each lot of cows was fed for one whole period on each kind of food. Annie refused the cotton seed ration and hence in the second period it was necessary to substitute Hypatia.

Composite samples of the milk were tested weekly by the Babcock test and the amount of fat thus found was converted into butter by the usual method of multiplying by one and one-sixth.

*Amount, kind and cost of food eaten.*

		Pounds food in 28 days.						Cost of food.	
Period. (each 28 days.)	Cow.	Cotton seed.	Sorghum hay.	Cotton seed meal.	C. S. hulls.	Wheat bran	Corn meal.	In 28 days.	Per day.
I	Jan. 16 to Feb. 12. }								Cents.
I	Ada....	287	288	.....	.....	95	95		
I	Queen..	246	233	.....	.....	72	72		
II	Feb. 23 to Mar. 22. }								
II	Rozena.	290	270	.....	.....	97	97		
II	Hypatia	193	212	.....	.....	64	64		
Total,	4 cows...	1016	1001	.....	.....	328	328	\$18.57	
II	Ada.....			220	419	125	125		
II	Queen...			248	467	140	140		
I	Rozena...			251	478	148	148		
I	Annie...			161	307	92	92		
Total,	4 cows...			878	1678	500	500	\$21.63	19.8

The cows receiving the "oil mill" ration ate much more heartily than the others, the cotton seed making the "farm-grown" ration relatively unpalatable. The amounts eaten daily per head were as follows, taking the average for four cows on each food:

	Lbs.		Lbs.
Cotton seed, raw.....	9.07	Cotton seed meal ..	7.83
Wheat bran ..	2.93	Wheat bran ..	4.38
Corn meal ..	2.93	Corn meal ..	4.38
Total concentrates..	14.93	Total concentr'ts..	16.59
Sorghum hay ..	9.10	Cotton hulls ..	14.90
Total food ..	24.03	Total food.....	31.49

The average daily cost of food per day was 12.1 cents per cow with the farm-grown ration and 19.3 with the oil mill ration.

While it cost much more to feed the cows on the purchased ration, we may not pronounce this the least economical ration until we have noted the amount of butter produced by each.

*Milk and butter produced by feeding a ration consisting largely of cotton seed and sorghum hay vs. one containing cotton seed meal and hulls.*

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	Lbs.			Lbs.	Lbs.
I	Ada.....	582.1	24.38	II	Ada.....	689.0	29.90
I	Queen.....	588.0	27.78	II	Queen.....	914.1	38.80
II	Rozena.....	688.8	29.00	I	Rozena.....	1179.5	46.16
II	Hypatia.....	514.7	28.60	I	Annie.....	689.1	34.90
Total,	4 cows, 28 days	2321.1	109.62	Total,	4 cows, 28 days	3371.7	147.28
Av.	Per cow, per day.....	20.7	.98	Av.	Per cow per day.....	29.6	1.81

The product obtained was greater with the oil mill ration, the increase in milk being 43 per cent and in butter 34 per cent. This increased production of milk and butter with the purchased ration is due largely, if not entirely, to the larger quantities of food consumed.

If we take 20 cents per pound as the value of the butter and assume that the manure and skim milk have sufficient value to pay for the labor of caring for the cows and making the butter, we have the following statement of the cost and profit on butter.

*Financial statement.*

	With farm grown ration.	With oil mill ration.
Value of butter from 4 cows, 28 days.....	\$21.92	29.56
Cost of food, 4 cows, 28 days.....	13.57	21.63
Profit from 4 cows, 28 days.....	8.35	7.93
Cost of food per pound of butter, cents.....	12.1	15.2
Daily profit per cow, cents.....	7.5	7.1
Profit per pound of butter, cents.....	7.9	4.8

The butter was produced at a cost of 12.1 cents per pound when the cotton seed and hay ration was fed and of 15.2 cents per day when cotton hulls and meal were fed in maximum amounts. Yet the daily production was so much larger on the last mentioned ration that the average daily profit per cow is nearly the same with both rations, viz. 7.5 cents with farm foods and 7.1 cents with oil mill products.

**SECOND EXPERIMENT; PURCHASED VS. FARM-GROWN  
RATION IN 1901.**

In January and February 1901 the experiment of the preceding winter was repeated, with slight modifications in the rations.

The foods were mixed in the following proportions, and the cows were allowed to eat as much of each mixture as they would.

<i>Farm grown ration.</i>	<i>Purchased ration.</i>
9 lbs. raw cotton seed.	5.25 lbs. cotton seed meal.
3 lbs. wheat bran.	3 lbs. wheat bran.
10 lbs. sorghum hay.	10 lbs. cotton seed hulls.

Prices used in calculating the cost of butter are the same as in the former experiment.

The experiment extended over a similar period of time, two periods of 28 days each, both preceded by a week of

preparatory feeding. The first period extended from January 1 to 28, 1901, the second from February 5 to March 4 inclusive.

Lot 1 consisted of two cows, and Lot II of three cows. The different number of cows in the two lots does not affect the accuracy of the results, for at the conclusion of the first period the rations were reversed, thus making each cow at different times during the experiment consume both rations.

The cows employed were as follows:

	Breed.	Age. Years.	Days since calving.	Weight when test began.
Ida.....	Jersey.....	5	110	810
Hypatia ..	do	5	18	740
Annie.....	do	11	87	795
Ada.....	do	9	48	880
Susan...	do	8 (1st calf)	141	610

*Amount, kind, and cost of food eaten.*

Period.	Cow.	Lbs. food in 28 days.					Cost of food.	
		Cotton seed.	Sorghum hay.	Cotton seed m. al.	Cotton seed hulls.	Wheat bran	In 28 days.	Per day.
I	Ida.....	258	207	.....	.....	86	\$10.61	Cents. 7.5
I	Hypatia.....	275	242	.....	.....	92		
II	Annie.....	175	185	.....	.....	58		
II	Ada.....	200	180	.....	.....	66		
II	Susan.....	168	162	.....	.....	56		
Total,	5 cows.....	1078	926	.....	.....	358		
II	Ida.....	.....	.....	235	449	134	\$21.60	15.4
II	Hypatia .....	.....	.....	272	519	155		
I	Annie ..	.....	.....	193	368	110		
I	Ada.....	.....	.....	256	490	147		
I	Susan.....	.....	.....	189	360	108		
Total,	5 cows .....	.....	.....	1144	2186	654		



As in the former experiment we were unable to induce the cows to eat the desired amount of the cotton seed ration.

The food consumed per head daily averaged as follows:

	Lbs.		Lbs.
Cotton seed, raw ...	7.68	Cotton seed meal...	8.17
Wheat bran .. . . .	2.56	Wheat bran .....	4.66
<hr/>		<hr/>	
Total concentrates..	10.24	Total concentrates..	13.83
Sorghum hay .....	6.61	Cotton seed hulls...	15.60
<hr/>		<hr/>	
Total food .....	16.85	Total food .....	29.43

The average daily cost of food was 7.5 cents per cow with the farm-grown ration and 15.4 cents with the oil mill ration. However, the more expensive ration gave the larger product, as appears below:

*Milk and butter produced by feeding in 1901 a ration consisting largely of cotton seed and sorghum hay versus one containing cotton seed meal and hulls.*

Cotton seed and hay ration.				Cotton seed meal and hulls ration.			
Period.	Cow.	Milk.	Butter.	Period.	Cow.	Milk.	Butter.
		Lbs.	Lbs.			Lbs.	Lbs.
I	Ida.....	359.2	21.09	II	Ida.....	523.8	29.00
I	Hypatia.....	532.7	30.44	II	Hypatia.....	640.8	28.78
II	Annie.....	380.9	22.42	I	Annie.....	607.8	32.22
II	Ada.....	409.5	22.70	I	Ada.....	549.2	28.79
II	Susan.....	818.6	26.89	I	Susan.....	446.3	31.76
Total...	5 cows, 28 d'ys	2000.9	123.04	Total...	5 cows, 28 d'ys	2767.4	148.50
Av. per cow per day		14.86	.88	Av. per cow per day		19.0	1.06

The purchased ration afforded an increase over the farm-grown ration of 32 per cent. in milk and 21 per cent in butter. Of course this increase must be attrib-

uted chiefly to the fact that larger amount of the former were consumed on account of its greater palatability.

With butter at 20 cents per pound and food stuffs at same prices as in the former experiment we obtain the following:

*Financial Statement.*

	With farm-grown ration.	With oil mill ration.
Value of butter from 5 cows, 28 days. ....	\$24.61	\$29.70
Cost of food, 5 cows, 28 " ....	10.61	21.80
Profit from 5 cows, 28 " ....	14.00	8.10
Cost of food per pound of butter, cents.	8.6	15.4
Daily profit per cow, cents .....	10.0	5.8
Profit per pound of butter, cents .....	11.4	4.6

The farm-grown ration afforded a greater profit whether we use as a basis the daily profit per cow or the profit on each pound of butter; this latter profit was 11.4 cents when the cotton seed ration was fed and 4.6 cent when the meal and hulls ration was employed.

Attention is called to the excellent record made by the Jersey heifer Susan.

Although she had calved nearly five months before her experimental feeding began, yet she averaged 1.14 pounds of butter per day during the 28 days while receiving cotton seed meal.

AVERAGE RESULTS OF THE TWO EXPERIMENTS.

Taking the averages of the figures in the two experiment we find:

	With cotton seed ration.	With oil mill ration.
	Cents.	Cents.
Cost of food per pound of butter.....	10.35	15.3
Daily profit per cow .....	8.75	6.45
Daily production of butter per cow, lbs...	.93	1.19
Daily production of milk per cow, lbs...	17.53	24.3

With the oil mill ration the daily production of butter was larger by 28 per cent and the daily flow of milk by 38 per cent. But the amount of food consumed, and hence the daily cost, was so much greater than with the farm-grown ration that the latter was decidedly more profitable.

#### EFFECTS OF RATIONS ON WEIGHT AND HEALTH OF COWS.

##### *Effect of food on live weight.*

	Period beginning.	Weight at begin- ning.	Weight at end of period.	Gain(+) or loss(-) in 28 days.	
				On farm ration.	On oil mill ration.
Ada .....	Jan. 16, 1900. . .	816	882	+ 16	
Queen .....	do	980	970	-- 10	
Ada .....	Feb. 23, 1900. . .	862	861	....	- 1
Queen .....	do	1008	1072	....	+ 69
Rozena .....	Jan. 16, 1900. . .	1150	1175	....	+ 25
*Annie .....	do	762	775	....	+ 13
Rozena .....	Feb. 23, 1900 . .	1152	1165	+ 13	
*Hypatia .....	do	703	705	+ 2	
Ida .....	Jan 1, 1901. . .	810	785	- 45	
Hypatia .....	do	740	700	- 40	
Ida .....	Feb. 5, 1901. . .	790	795	....	+ 5
Hypatia .....	do	730	755	....	+ 25
Annie .....	Jan. 1, 1901. . .	795	767	....	- 28
Ada .....	do	830	840	....	+ 10
Susan .....	do	610	610	....	0
Annie .....	Feb. 5, 1901. . .	745	697	- 48	
Ada .....	Feb. 5, 1901. . .	845	780	- 65	
Susan .....	Feb. 5, 1901. . .	610	585	- 25	
Total net gain .....				-202	+ 118
Average per cow. per period of 28 days. ....				22.4	13.3
Average per cow. per day .....				-.8	+.5

\* Hypatia substituted for Annie in 2d period.

The gains in live weight during the first two feeding periods are not of particular interest so far as the rations are concerned, but they seem to depend upon the individuality of the cows. Ada gained 16 lbs. on the farm-grown ration and practically held her own on the "oil mill ration" losing only 1 pound. Queen lost

10 pounds on the farm-grown ration and gained 69 lbs. on the "oil mill ration." With the other two cows there was a slight gain in both periods.

On an average the cows on cotton seed lost in weight .8 of a pound per day, while those on the meal and hulls ration, consuming more food, gained .5 of a pound daily. The rations fed during the second experiment were decidedly laxative and the cows showed it in the milk yield and in the loss of live weight. In 1900 the raw cotton seed fed constituted 37.7 per cent of the "home-grown ration," while in 1901 it constituted 45.50 per cent of the "home-grown ration."

In 1900 the cotton seed meal fed formed 24.8 per cent of the "oil mill ration" and in 1901 it formed 27.7 per cent.

The table of live weight shows that in the second experiment all the cows lost in weight when on the farm-grown ration, while only one fell off on the "oil mill ration." The effect of cotton seed and cotton seed meal varied with the different animals, the greatest scouring being with cotton seed. In the first experiment Rozena, a very large cow, consumed an average of 8.9 pounds of cotton seed meal daily and appeared well in every way, while in the second period she consumed 9.6 pounds of cotton seed and did not show the effects for three weeks, when she scoured very heavily and fell off in milk flow. This was undoubtedly due to the large amount of oil in the cotton seed. In the second experiment Susan, a small heifer, took 6 pounds of cotton seed per day for the first period and appeared at her best during the whole of the month, but six days after being on cotton seed meal in the second period, getting 6.7 pounds per day, she commenced to scour and fell off in milk flow. This could not be due to a larger amount of oil in the ration, but

probably to the influence of the previous month's feeding of cotton seed, modified by the individuality of the cow. A cow that scours, even though it be slight, can not do her best at the pail.

In feeding cotton seed and cotton seed meal, as well as other feed stuffs, one must not rely on tables entirely, but be guided largely by the individuality of the animal with which he is dealing. The amounts of cotton seed meal used in the above experiments are larger than the writers would advise.

**THE AMOUNT AND QUALITY OF MANURE COLLECTED FROM  
COWS ON DIFFERENT RATIONS.**

*First experiment, 1900.* The manure, both liquid and solid, was saved every day, except that dropped when the cows were out of the barn and in bare lots where they spent the time between 8 a. m. and 4 p. m. Hence the manure actually saved consisted only of that dropped during 16 hours of each day, or of that voided during two-thirds of the time.

The liquid manure was saved by the use of sawdust as bedding material. The manure was removed every day to a shed, the roof of which consisted of 12-inch boards without battens, and hence having small cracks every twelve inches. This leak kept the manure moist but seems not to have resulted in any appreciable amount of leaching.

The manure (including sawdust) collected during the time that the cows stood in the barn was as follows:

		Lbs. in 28 days, 2 cows.	Lbs. daily per cow.
From cotton seed and hay ration, 1st 28 days.....		1785	
From do 2nd 28 " .....		1700	
Total and average .....		3485	81.04
From cotton seed meal and hulls ration, 1st 28 days. 2115			
From do 2nd 28 " 2430			
Total average .....		4545	40.6

These several lots of manure were applied to various farm crops; to ascertain the real or agricultural value of the two kinds of manures we must wait until the crop returns for several years can be reported.

No analyses of the manure was made in the experiment conducted in 1900.

The bedding used was fresh yellow fine sawdust, which in the first experiment was dry enough, but that used in the experiment of 1901 was too moist to be entirely satisfactory. The amounts of sawdust used per period (and included in the figures given above for manure) were with the cotton seed ration 391 and 639 pounds in the respective periods; with the cotton seed meal ration 520 and 644 pounds, respectively.

*Second experiment, 1901.* The same method as in 1900 was employed in collecting and handling the manure dropped during the 16 hours per day that the cows spent in the barn. Only during the second period of this experiment was the manure kept separate and weighed.

The weights given are those obtained by weighing the bulk of manure and soiled bedding at the conclusion of the experiment.

The data follows:

	Lbs. manure from 2 cows, 28 days.	Lbs. manure daily per cow.
From cotton seed and hay ration....1900		35.7
From cotton s. meal and hulls ration.3138		56.0

These two lots of manure, each collected during parts of 28 days, were applied to farm crops, and the effects of these two classes of cow manure as compared with each other, with commercial fertilizers, and with no fertilizer, will be recorded in future bulletins of this Station.

The two lots of fertilizers collected as above during the last 28 days of the experiment, were carefully sampled at the end of the experiment and promptly analyzed; and the following table gives the results calculated by us from the analyses made by the chemical department of the Station:

*Nitrogen, phosphoric acid, and potash in cow manure, 1901.*

	From cow manure.	
	Cotton seed and hay ration.	C.S meal and hulls ration.
<i>Composition.*</i>		
Nitrogen, ..... per cent.....	0.535	0.830
Phosphoric acid, per cent.....	.340	0.350
Potash, ..... per cent.....	.500	0.485
Moisture, ..... per cent.....	64.00	66.140
<i>Pounds in 1 ton of manure.</i>		
Nitrogen, ..... lbs.....	10.7	16.6
Phosphoric acid, ..... lbs.....	6.8	7.0
Potash, ..... lbs.....	10.0	9.7

The matter that is most worthy of note in the table above is the fact that manure made from a diet consisting largely of cotton seed meal and hulls is 55 per cent. richer in nitrogen than that made from the cotton seed and hay ration; a ton of the former contains 16.6 pounds of nitrogen as compared with 10.7 pounds of nitrogen in the manure from the latter or farm ration. As regards phosphoric acid and potash the two manures are on a practical equality.

\* In 1901 the manure dropped during the day when the cows were confined for the *entire 24 hours* was also analyzed, the comparison being almost exactly the same as that of the manure saved during the second period of 28 days (see table above). There was in this fresh manure made from cotton seed, etc., 68.3 per cent. moisture; 0.515 per cent. nitrogen; 0.30 per cent. phosphoric acid; 0.39 per cent. potash. In the manure made from cotton seed meal the percentages were respectively. 68.37; 0.78; 0.325; 0.40. The only notable difference is in the nitrogen, of which the manure from the oil mills ration contained 51 per cent. more than was found in the cotton seed ration.

# PROPORTION OF TOTAL EXCREMENT DROPPED IN BARN.

In order to determine what proportion of the manure was dropped in the barn and what percentage in the lots during the eight hours that the cows daily passed in the latter, two cows getting the farm ration and two receiving the purchased foods were kept in the barn for 24 and 48 hours after the close of the experiment, the rations meantime being continued without change.

## *Solid & liquid excrement per cow in 24 hours.*

Cotton seed ration.				Cotton seed meal ration.			
Cows.	Date.	Total excrement and sawdust.		Cows.	Date.	Total excrement and sawdust.	
		Solid	liquid			Solid	liquid
		Lbs.	Lbs.			Lbs.	Lbs.
Ada and Queen	Feb. 13 & 14, 1900	55.8	47.8	Ada and Queen	Mar. 23 & 24, 1900	87.2	72.6
Rozena & Hypatia.	Mar. 23 & 24, 1900	73.1	56.8	Rozena & Annie.	Feb. 13 & 14, 1900	61.5	46.1
Ada and Susan.	Mar. 6, 1901	53.8	..	Queen & Hypatia.	Mar. 6, 1901	108.8	..
Average ...	per cow	60.9	..	Average ...	per cow	84.2	..
Average ...	per 1000 lbs. live weight.	72.5	..	Average ...	per 1000 lbs. live weight.	89.8	..

The average amount of solid and liquid droppings and bedding per cow was 60.9 pounds per day with the ration containing cotton seed and 84.2 pounds per day with the ration containing cotton seed meal.

In 1900, with the cotton seed ration, the average amount of solid and liquid excrement dropped per cow in 24 hours (excluding bedding) was 52.3 pounds; the average daily amount of excrement (free from sawdust) collected during the 16-hour stabling period of each day was only 21.9 pounds.



In 1900, with the cotton seed meal ration, the average amount of excrement, free from sawdust, dropped per cow in 24 hours was 59.4 pounds; the average amount collected during the 16 hours of stabling was only 30.2 pounds.

Apparently about one-half the manure was dropped in the barn and about one-half in the lots.

This statement is important because the manure dropped on the lots or pastures usually suffers greater losses, and hence is worth less than that collected while the cows are in the stable. However, the high value of manure from grain fed cows should prompt every dairyman to gather and protect the manure from the lot as well as that from the barn.

In conclusion let us note that the manure from the cotton seed meal ration was greater in amount and much richer in nitrogen than that from the cotton seed ration. Taking the average amounts of manure in all cases where the cows were confined for the whole day and using the analysis of the samples collected in the last period of 28 days in 1901, we find that the daily excretion of liquid and solid excrement (including bedding) contained plant food as follows:

	Lbs. nitrogen.
60.9 lbs. manure from cotton seed ration.....	.306
84.2 lbs. manure from cotton seed meal ration....	.700

With the cotton seed meal ration the daily output of nitrogen in the manure was more than twice as great, and the amounts of phosphoric acid and potash considerably larger than with the ration made up largely of cotton seed.

**GREEN RYE SUBSTITUTED FOR COTTON SEED HULLS AND FOR  
SORGHUM HAY.**

For 3 weeks beginning March 22, 1900, the four cows which had been used in the experiment comparing a farm-grown with a purchased ration, were fed on green rye as a substitute for the cotton seed hulls and for the sorghum which they had been eating during the second period. The grain ration of the second period was continued in same proportions but in greatly reduced amounts. The rye was in full bloom and rather too old. Excluding the first, or preliminary, week, we find that the result for period III, consisting of 14 days, were as stated below:

*Food consumed and milk and butter afforded by 2 cows in 14 days from different rations.*

	Lbs. food in 14 days.				Gain or loss in weight	Cotton seed ration.		Cotton seed meal ration.	
	Green rye.	Cotton seed.	Cotton seed meal	Bran and corn mixture. 1:1.		Milk.	Butter.	Milk.	Butter.
						Lbs.	Lbs.	Lbs.	Lbs.
Ada.....	773	...	50 0	36 0	+ 8	.....	.....	298.9	12 78
Queen.....	699	...	73.4	83 9	— 32	.....	.....	424.0	13.38
Rozena.....	783	88 8	.....	59 8	— 7	364 8	18 15	.....	.....
Hypatia.....	781	52 8	.....	35.2	— 14	272 9	15 27	.....	.....
Total, 2 cows	.....	.....	.....	.....	.....	687 7	28 42	722.9	26 06

Counting green rye at \$2.00 per ton and other food-stuffs at prices before mentioned, we find that the cost of food to make one pound of butter was 15.4 cents when cotton seed meal was fed and only 10.5 cents when cotton seed was fed.

This difference in favor of cotton seed over cotton seed meal as an economical producer of butter is apparently too great to be attributed to individual peculiarities of the cows of the two lots, which were chosen with reference to their practical equality.

Direct comparison of green rye as a substitute for either cotton seed hulls or sorghum hay can not be made in this experiment. However the substitution of rye for cotton seed hulls, and also for sorghum hay, reduced the cost of butter, partly perhaps because the large amount of green rye eaten made it practicable to reduce the amount of concentrated food.

Comparing the average daily product during period III with that of the last two weeks of period II, and making no allowances for the fact that the cows while on rye were further removed from time to time of calving than when receiving sorghum or cotton seed hulls, we find:

(1) That the substitution of 52 lbs. of green rye for 14.9 lbs. of hulls (grain also being reduced when rye was fed thus changing the nutritive ratio from 1:4 to 1:3.7), was accompanied by a shrinkage of 19 per cent. in butter and 9 per cent in milk.

(2) That the substitution of 54 lbs. of green rye for 9.1 pounds of sorghum hay (grain also being reduced when rye was fed, changing the nutritive ratio from 1:6.5 to 1:7.3) increased the yield of milk by 18 per cent. and the yield of butter to the extent of 6 per cent.

The results of feeding rye were highly satisfactory

for they show that rye was practically able to maintain the normal product (actual yield corrected for advance in location) of butter and to slightly increase that of milk and that its use allowed the daily ration of concentrated food to be decreased to the extent of more than 5 pounds per day, without materially impairing the amount of product. These facts and figures point to an increased use of green crops in late winter and early spring as an effective means of reducing the bill for purchased foodstuffs. An uninterrupted succession of crops for feeding green (soiling) may be had by the use of rye, wheat, common oats, hairy vetch (mixed with small grains), turf oats, and sorghum, etc.

Since the health and working capacity of cows are so greatly improved by soiling crops they should find increased favor.

#### EFFECT OF GREEN FOOD ON RICHNESS OF MILK.

It is a common belief that milk made from green food contains more water and less fat than that from dry foods. The results of the few experiments made on this point do not bear out the popular belief.

Our results on this point were obtained by making a composite test for butter fat, once a week.

It should be recollected that these determinations of fat were not begun until after the cows had been eating rye for a week. For comparison, we give the percentages of fat found in the milk of the same cows for the weeks beginning March 9 and March 16, 1900, at which time they were receiving only dry food, and a heavier grain ration (though similar in kind) than was given with the rye.

*Per cent. of fat in milk; results of composite weekly tests.*

NAME.	On dry food, and heavy "grain" ration.		With green rye, and moderate "grain" ration.		
	Date.	Per cent. fat.	Date.	Per cent. fat.	Loss on green food.
Ada.....	Mar. 9-15...	3.7	Mar. 30-A. 5.	3.5	.20
	Mar. 16-22..	4.0	Apr. 6-12...	3.8	
Queen.....	Mar. 9-15..	3.2	Mar. 30-A. 5.	3.	.40
	Mar. 16-22	3.4	Apr. 6-12...	2.8	
Rozena.....	Mar. 9-15..	4.1	Mar. 30-A. 5	3.0	1.05
	Mar. 16-22..	4.2	Apr. 6-12...	3.2	
Hypatia....	Mar. 9-15...	5.0	Mar. 30-A. 5	4.8	.00
	Mar. 16-22..	4.6	Apr. 6-12...	4.8	
Average decrease in % fat	.....	.....	.....	.....	.41

The uniformity of the figures indicate a decrease in per cent. of fat in the period when rye was fed. It cannot now be said whether it was due to the green food, to temperature conditions, or to a large reduction in the grain ration. The effect of green foods as fed in the South on the percentage of fat in the milk requires further study.

#### DIGESTIBLE NUTRIENTS IN THE SEVERAL RATIONS FED.

The following table given the amount of digestible nutrients consumed per day in the different periods in comparison with the German or Wolff-Lehmann Standard, which represents the daily requirements of an average cow in full flow of milk:

*Digestible nutrients in rations fed.*

Ration.	Average weight of cows.	Dry matter.	Digestible nutrients.			Milk per day.	Nutritive ratio.
			Protein.	Carbohy- drates.	Ether extract.		
Wolff-Lehmann Standard. . . . .	Lbs. 1000	Lbs. 29	Lbs. 2.5	Lbs. 13	Lbs. .5	Lbs. 22	Lbs. 1:5.7
"Farm-grown," 1900..	915	18 75	1 85	9.21	1 81	20.7	1:7.8
"Oil mill," 1900.....	957	28.19	8.82	11 98	1.01	29 6	1:3.7
"Farm-grown," 1901..	772	13.07	1.37	5.76	1.42	14.8	1:6.6
"Oil mill," 1901.....	752	25 46	8.64	8.86	1.38	19.0	1:3.2
Rye & cotton s., 1900..	970	20 9	2 2	11.2	1 81	22.7	1:6.5
Rye & c. s. meal, 1900.	980	20.6	8.21	10 71	.90	25.8	1:4.0

Speaking in general terms, protein is that part of the food that goes to make milk, muscle, bone, etc., while carbohydrates (starch, sugar, etc.) and ether extract (fat, etc.) are used as fuel and to give force. Protein is nitrogenous material, and carbohydrates and ether extract are non-nitrogenous. Both classes of compounds must be present in the food to keep the body in its normal working condition.

The average daily ration per cow was as follows:

**Cotton seed ration—**

5.6 lbs. cotton seed.

37 lbs bran and corn mixture.

54 lbs. green rye.

**Cotton seed meal ration—**

4.4 lbs. cotton seed meal.

5.0 lbs. bran and corn mixture

52 lbs. green rye.

It should be noticed that the cowing eating the cotton seed ration could never be brought up to full feed, or the amount necessary to produce a full flow of milk; in one experiment their ration dropped nearly down to half

what the Germans have found to be desirable for a cow to eat.

On the other hand the cows getting cotton seed meal in all cases consumed more protein than necessary.

The nutritive ratio is the number of times that the ratio of the amount of protein (taken as 1) to the total amounts of carbohydrates and fats, the fats having first been multiplied by  $2\frac{1}{2}$ . The nutritive ratio was narrow (represented by a small number) when cotton seed meal was fed, and wider (or less rich in nitrogen or protein) when cotton seed was fed.

#### VALUE OF COWPEAS IN CORN FIELDS AS PASTURAGE.

For a period of 19 days, October 7 to 25 inclusive, 1900, three Jersey cows were grazed in a corn field from which the ears had been pulled, the grazing consisting principally of cowpeas, of what remained of the corn blades, and of a little crab and crowfoot grasses.

The corn was planted March 28 in rows five feet apart. Half way between the corn rows was a row of drilled Wonderful cowpeas planted June 4, without fertilizer. The yield of corn was about 25 bushels per acre.

While the cows were grazing in the corn field on cowpeas each received a daily allowance of 3 pounds of cotton seed meal.

From September 23 to October 6 each cow also consumed 3 pounds of cotton seed meal per day. During this earlier period of three weeks, they grazed in a large pasture of bermuda, lespedeza, (Japan clover, carpet grass, etc.) so that the yields made on pea vines can be properly compared with those made on ordinary pasturage. The following table shows the amount of milk and butter afforded daily by each cow:

*Average amount of milk and butter produced daily.*

Cow.	Milk from		Butter from	
	Mixed pastur'ge.	Cowpeas, etc.	Mixed pastur'ge.	Cowpeas, etc.
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
Ida.....	23.94	25.53	1.03	1.13
Houren.....	9.72	15.5	.81	.97
Susan.....	17.64	18.37	1.00	1.01
Average per cow, daily.	17.1	19.8	.95	1.04
Per cent. increase ..	.....	15.8	.....	9.5

Comparing the product obtained when the cows grazed on cowpeas with that made from ordinary pasturage, we find that the cowpeas gave an average increase of 15.8 per cent in milk and 9.5 per cent in butter. It should be noted that this increase occurred in spite of the fact that the cows were further advanced in the period of lactation when grazing on cowpeas than when on ordinary pasture.

The total amount of product obtained from the three cows during the 19 days while they grazed on cowpeas in a corn field of 3.03 acres was 1129.5 pounds of milk and 59.17 pounds of butter. During this time the three cows consumed a total of 171 pounds of cotton seed meal.

The three cows Ida, Susan, and Houren, during the 19 days while pasturing on cowpeas made gains in live weight of 2687 pounds, subsisted for a period of 85 pounds for the lot. When the field was grazed so close as to threaten to reduce the milk flow, these three cows were removed and three dry Jersey cows were substituted. These three dry cows, with a total initial weight of 2687 pounds, substituted for a period of 9 days on what remained of the grazing on 3.03 acres, meantime receiving no other food whatever and making gains of 12, 16, and 25 pounds, a total of 53 pounds for the lot. Adding this to the 85 pounds gained by the cows giving milk, we have a total gain in live weight of 138 pounds.



The returns from grazing 3.03 acres of cowpeas are brought out by the following:

*Financial statement.*

By 59 17 lbs. butter. @ 20c .....		\$11.80
By 188 lbs. increase in live weight, @ 2½c .....		3.45
To 171 cotton seed meal. @ \$20 .....	\$ 1.71	
Balance (value of 3.03 acres pasturage) .....	13 54	
Total .....	\$ 15.25	\$15 25

Since \$13.54 represents the returns from 3.03 acres, the value of the grazing on one acre is \$4.47.

The peas were planted for their fertilizing value and the butter removed practically none of this. Hence the cost of growing the peas should be charged in the fertilizer bill of the following crop, and not to the butter produced. However, if it be insisted that this is a proper charge against the cows the expense consists only of the cost of seed, labor of dropping and of covering, the total being somewhat less than a dollar per acre.

If we charge all of this expense of growing the peas to the cows giving milk and entirely neglect the gains made in live weight (the value of which was greater than the cost of growing the peas) the cost of concentrated feed and of pasturage was 8 cents per pound of butter. Balancing gains in live weight against cost of making the pea crop, we have 2.9 cents as the cost of purchased food per pound of butter.

Since there are more farmers interested in beef production than in commercial dairying, we have made an estimate as to the amount of growth of beef cattle that might be expected on an acre, using Thorne's figures as to the relative amounts of food required to make a pound of butter and of beef. By this method we estimate that an acre of grazing of this character made without the aid of any other food, animal products equal to about 80 pounds of increase in live weight. This is confessedly only an estimate but it is in accord with the small amount of data from other sources which is available on this subject.

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BULLETIN No. 115.

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AUGUST, 1901.

ALABAMA

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## COMMERCIAL FERTILIZERS

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JAS. T. ANDERSON,

Acting Chemist.

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A. ROEMER,  
PRINTER FOR STATE OF ALABAMA,  
MONTGOMERY, ALA.

1901.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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\*To be filled.

AUBURN, ALA., July 24, 1901.

HON. R. R. POOLE,

Commissioner of Agriculture,  
Montgomery, Alabama.

DEAR SIR:

I have the honor to submit herewith, in tabulated form, a report of the results of analyses of commercial fertilizers and miscellaneous fertilizing materials for the year ending July 1st.

A large majority of these samples were forwarded to this laboratory through your office, and certificates of analysis were furnished you from time to time as the work was finished. A large number, however, were sent direct to us from dealers and consumers, and in all these cases certificates of analysis were sent direct to the parties.

In addition to the analysis reported in this bulletin, analyses, both quantitative and regulative, of various miscellaneous substances—ores, marls, minerals, waters, dairy products, &c.—have been made for parties from all sections of the State, and have been reported from time to time.

As an introduction to the tables, I respectfully submit a few observations on "Fertilizers—their selection and use," which, it is hoped, will prove of some practical value to the farmers who receive this bulletin.

Very respectfully,

JAS. T. ANDERSON,  
Acting State Chemist.

## Fertilizers--Their Selection and Use.

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Few farmers need be reminded of the necessity of applying fertilizers in some form to their soils in order to maintain their fertility and to increase their crop producing power. The question is not "Shall I fertilize?" but rather "What fertilizers shall I use?" It is proposed in this brief discussion to offer a few suggestions which it is hoped, will be of some value in this connection. These must be taken as suggestions merely, and not as absolute guides in solving the problem. In the present state of knowledge of the science of agriculture, it is impossible to state any general principle of soil fertilization which will be of universal application, so complex are the conditions and requirements to be considered. The character of the soil and the method of its cultivation, the crop to be grown, the season—all these are to be considered in devising any rational system of fertilization.

A soil is fertile when it contains all the materials nec-

essary for plant growth in the required quantity and in the proper form. A soil which is lacking in any of these materials, or which does not have them in the proper form, is in no condition to produce a full crop, and must have the deficient material supplied in the proper amount and form in order to make it productive. As has frequently been stated in these bulletins, there are about a dozen constituents of the soil that are required for plant nutrition. Most of these are found in such quantity in the soil, or are in such little demand by the plant, that the supply of them in the soil is not likely to be exhausted by years of cultivation. Three of the constituents, however, nitrogen, phosphoric acid and potash, are in such demand by the plant that their supply is readily exhausted, and it is necessary to restore these exhausted constituents to the soil in order to make it fertile. For the present, then, soil fertilization consists in restoring to the soil nitrogen, phosphoric acid and potash in such quantities in assimilable form as may be required for the proper nutrition of the growing crop. The rational course, therefore, to pursue with reference to a given soil is first to determine its deficiency in these three constituents and then to supply the deficiency in proper form.

It is not an infrequent occurrence for this department to receive a sample of soil with the request to tell what it needs for its proper fertilization. The correspondent is acting on the hypothesis that a chemical analysis of a soil will determine its fertilizer requirements. Unfortunately it will not do so satisfactorily. The chemist can easily determine what constituents are present in the soil and in what quantities, but he cannot so readily determine whether these constituents are present in assimilable form, and if they are not present in assimilable form, they might as well be absent altogether, as far as

the present needs of the growing plant are concerned. Many agricultural chemists, in this and other countries, are seeking to discover methods for determining available or assimilable plant food in soils, but at present there is no such method known which is satisfactory and which admits of universal application.

If chemical analysis fails to answer the question, it may be asked, is there not some way by which the solution may be found? In answer let us quote the language of Dr. Armsby of the Pennsylvania station: "The most satisfactory, and, indeed, usually the only method by which we can at present determine the needs of the soil is to ask the question of the soil itself by growing a crop upon it with different kinds of fertilizers and noting the results. Such soil tests with fertilizers have in many cases given results of much immediate practical value for the locality in which they were undertaken."

On this plan have been conducted for several years the Cooperative fertilizer tests for cotton under the direction of Professor Duggar of the Agricultural Experiment Station of this State, and much valuable information has been accumulated thereby. It would be highly advantageous to the agricultural interests of the State if this work could be greatly extended beyond its present limits. It seems to the writer quite feasible for each intelligent farmer to conduct the experiments for himself and thus secure data that would be highly useful to him. At first glance they may seem complicated and expensive, but in reality they are neither so difficult nor so expensive as they seem. For the benefit of any farmers who may desire to make them the following suggestions are offered:

Select ground that represents fairly as large an area of the farm, and whose soil is as uniform in character as

possible. A long strip of land is likely to be more representative in character than a square piece, as it will contain more of the inequalities of the soil, and for this reason is to be preferred for the purpose of these experiments. The land should be as level as possible, and if not level, the plots should be so located that the fertilizers cannot be carried by rain from one plot to another. No part of the strip should be shaded by trees. A convenient size would be 33 feet wide by 416 feet long divided into 6 equal plots each 66 feet long, with a path 4 feet wide between the plots. Each plot, therefore, would be 33x66 feet and measuring exactly one-twentieth of an acre. Each plot should be separated from its neighbor plots, as well as from adjacent cultivated ground, by a 4 ft. path, so that the roots of the plants grown on it can get no fertilizer that is not intended for them. Of course these paths or borders should be kept reasonably free from grass and weeds, which would otherwise feed upon the fertilizers intended for the plants in the plots. Having divided up the plots as indicated and marked them by numbers from 1 to 6 inclusive, prepare the soil thoroughly in the usual way, after applying the fertilizers broadcast as follows :

Plot 1.	No fertilizer.	
Plot 2.	Nitrate of soda.....	20 lbs.
	Acid phosphate.....	60 "
Plot 3.	Nitrate of soda.....	20 "
	Muriate of potash.....	16 "
Plot 4.	Acid phosphate.....	60 "
	Muriate of potash.....	16 "
Plot 5.	Nitrate of soda.....	20 "
	Acid phosphate.....	60 "



Muriate of potash.....16 lbs.

Plot 6. No fertilizer.

The acid phosphate in these experiments should contain not less than 8 to 10 % of available phosphoric acid. If cotton is to be used in the experiment, use kainit in the place of muriate potash, taking 48 lbs. If legumes, such as clover, peas, beans or vetch, are to be used, cut the amount of nitrate of soda one-half. It is recommended that that crop be used in the experiments which is to be grown in the field the following season, in order that the results of the experiment may be directly applicable. In planting care should be taken to have the plants uniformly distributed over the plots, and as nearly as possible the same number of plants in each plot. The plots should be treated alike in all respects as to the time and manner of cultivation, and in passing from one plot to another, extreme care should be taken not to mingle the soil from one with that of another. This last caution is particularly applicable, when the plow is used in the cultivation. The harvest from each plot should be accurately weighed and the weights recorded. The importance of keeping a full and accurate record for each plot—the kind and amount of fertilizer used, the system of cultivation, and the harvest yield—cannot be too strongly urged. It will be observed that plots 1 and 6 have no fertilizer. These are check plots and are designed to show what the unfertilized soil can do. They will be especially useful in comparatively new soil or in soil that has been previously fertilized, but they should in no case be omitted.

If these experiments have been properly conducted, reasonable inferences may be drawn from a study of the results as to the fertilizer needs of the soil. Too much importance cannot be attached to the conscien-

tious carrying out of every detail. The experiments should be under the personal direction of the farmer himself, and where any part of the labor must be done by another, the most intelligent and reliable laborer should be selected for that purpose.

It is realized that but few farmers are likely to be induced to undertake these experiments, and in the absence of other means of determining the specific needs of the soil, most farmers must assume that all the constituents are needed and must supply them in such amount and in such form as the general considerations of the soil, season and crop may seem to require. So varied are these conditions that it would be impossible to give specific instructions as to methods of fertilization. A few general principles, however, as to the needs of special crops may be stated, which, it is hoped, will serve a useful purpose.

*Cotton* is a crop that responds promptly and profitably to judicious fertilization, and experience teaches that concentrated complete fertilizers should be used. The profit from manuring with concentrated fertilizers is greatly enhanced by properly preparing the soil in advance. It is profitable to bring the soil into a state of good "tilth" by proper cultivation, and particularly by incorporating into it liberal quantities of organic matter. This may be done by turning under leguminous crops (like the cowpea) or barnyard manure before planting. The complete fertilizer, applied in the drill, should contain a liberal amount of "available phosphoric acid." Any of the soluble salts of potash are good, though kainit is preferred, as it is believed to be useful in preventing "blight." Of nitrogen compounds the organic forms (cotton seed meal, dried blood, tankage, &c.,) are deemed to be best suited for cotton, though nitrate of soda

is excellent, especially in soils rich in organic matter. The proper proportions of available phosphoric acid, potash and nitrogen in a complete fertilizer for cotton cannot be said to have been determined with accuracy. As a result of numerous experiments at several of the agricultural experiment stations, 600 to 700 lbs. per acre of a fertilizer running 9% available phosphoric acid, 3% potash and 3% nitrogen is to be recommended.

*For cereals and grasses* nitrogen has been considered the dominant constituent. This arises from the fact that a top dressing of nitrate of soda at the season when there is a rapid development of stem and leaf, results in a largely increased crop. This occurs, however, only in soils which have a plentiful supply of the mineral constituents, phosphoric acid and potash. It is recommended, therefore, to use at the time of sowing a fertilizer containing a liberal amount of phosphoric acid and potash with a limited supply of nitrogen, and shortly before the maturity of the plant top dress with nitrate of soda.

*The Legumes* (clovers, peas, beans, vetches, &c.) are crops that do not depend solely on the soil for their nitrogen, but which, under favorable conditions, have the power of drawing at least a part of their nitrogen supply from the atmosphere. To this fact is due their superior excellence as soil renovators, since their growth upon a soil must result in its enrichment in the most costly of the fertilizer constituents, nitrogen. In fertilizing legumes, then, provide a liberal supply of the mineral constituents and a minimum of nitrogen. They seem to require potash in great abundance, Lime, also, is needed to correct a tendency to acidity in the soil which is hurtful to the growth of the bacteria so essential in order that the plant may acquire its nitrogen from

the atmosphere. 25 bushels of stone lime per acre, every 4 or 5 years, is recommended for average soils which are used for the frequent growth of legumes.

*Root and Tuber Crops* require an abundance of all the fertilizing constituents in readily available forms, but they differ widely as to their special needs. In one group may be placed *beets, carrots and mangels*. They require a liberal supply of readily soluble phosphoric acid and nitrogen, and in light, sandy soils the addition of a little potash is advisable. In clay soils they seem to be able to get most of the potash they require from the soil. *Turnips* respond most liberally to applications of available phosphoric acid, while they seem able to extract this constituent from sources not readily accessible to other plants. A liberal supply of nitrogen, also, especially during early growth, is desirable. While the turnip is a voracious feeder on potash compounds, it seems able to obtain this constituent from the natural soil supply, though it should not be required to depend solely on this supply. *Potatoes*, both irish and sweet, require a large amount of potash, which should be in the form of sulphate rather than of muriate. The nitrogen may be mostly in organic forms, though the nitrate of soda or sulphate of ammonia is recommended for the early irish potato. The phosphoric acid in moderate amount should be available.

*Fruit Crops* differ from the others that we have considered in that they are produced by perennial plants instead of by annuals, and hence they require a different sort of fertilization. As the plants grow slowly, fertilizing materials which give up their constituents slowly are better, perhaps, than those whose constituents are more readily available. Fertilizers of the latter class, however, may supplement those of the former with advantage at such times as there is a rapid devel

opment of leaf and fruit. Perhaps the best fertilizer for fruit trees is a mixture of ground bone 3 parts and muriate of potash two parts. An excess of nitrogen must be avoided, as this causes a too rapid growth of both wood and fruit, the latter ripening poorly under such conditions. All fertilizers for fruit crops should be worked well into the soil.

#### CALCULATION OF COMMERCIAL VALUES OF FERTILIZERS.

The schedule of valuations in force this season is as follows:

Nitrogen.....	14	cents per pound.
Water soluble phosphoric acid.....	5	“ “ “
Citrate soluble.....	5	“ “ “
Potash .....	5	“ “ “

To compute the commercial value of fertilizers according to this scale, the valuation per ton of water soluble and citrate soluble phosphoric acid and potash is obtained by multiplying the per cent of those constituents by \$1 00, while the value of the nitrogen per ton is ascertained by multiplying the per cent. of that element by \$2.80.

Take for example a fertilizer containing

7.50	per cent. of water soluble phosphoric acid.
2.00	“ “ “ citrate soluble “ “
1.25	“ “ “ potash.
2.50	“ “ “ nitrogen.

the commercial value per ton would be:

For the water soluble phosphoric acid	7.50x1.00	=\$7.50
“ “ citrate soluble	“ “ 2.00x1.00	\$2.00
“ “ potash	2.00x1.00	=\$2.00
“ “ nitrogen	2.50x2.80	=\$7.00

Total . . . . . \$17.75

**Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.**  
**ACID PHOSPHATES WITH NITROGEN AND POTASH.**

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.				Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	Nitrogen.		
6200	Alabama Phosphate (So called).....	N. M. Rhodes M. & M. Co., Shell, Ala..	5.90	5.13	2.42	1.56	1.15	\$16.56
6201	Alabama Fertilizer.....	" " " " "	6.90	2.35	1.80	1.96	2.76	17.50
6206	Dale County Standard Guano.....	Ozark C. S. O. M. & F. Co., Ozark, Ala.	8.75	3.17	1.08	1.64	3.25	19.76
6209	Ozark H. G. Guano.....	" " " " "	9.65	2.53	1.20	1.22	2.95	18.55
6210	Guano No. 8.....	" " " " "	9.70	2.89	1.36	1.24	2.52	18.08
6224	B'ham Dis. Bone Am. and Potash....	Birmingham Fert. Co., Birmingham, Ala.	10.00	3.38	.37	.99	1.05	17.20
6225	B'ham H. G. Blood, Bone & Potash.	" " " " "	10.23	3.85	.37	1.87	2.22	21.04
6229	Dale Co. Standard Guano.....	Ozark C. S. O. M. & F. Co., Ozark, Ala..	6.85	4.48	.50	2.36	4.11	21.55
6230	No. 2 Ozark Guano.....	" " " " "	7.45	5.78	.91	1.82	7.84	22.77
6231	Hemes Special Guano No. 1.....	Helm Bone Fert. Co., Birmingham, Ala.	0.00	5.49	6.16	1.80	2.29	12.82



6247	Soluble Blood and Bone	Troy Fertilizer Co., Troy, Ala.	7.10	2.48	3.52	1.26	1.66	14.77
6248	Blood and Bone Guano	" " "	8.25	2.85	2.20	1.60	2.00	17.58
6249	Dandee Guano	" " "	6.75	2.86	3.34	1.18	1.68	14.59
6254	Fertilizer	Cliff Foy & Bros., Abbeville, Ala.	8.55	2.96	.90	2.08	1.66	18.98
6257	Jones Special Formula	Hilton, Bentley & Cosby, Brantley, Ala.	7.35	2.45	3.09	1.10	3.70	16.58
6258	Gray's H. G. Guano	— Gray, Dadeville, Ala.	9.50	2.16	.44	1.50	2.34	18.20
6269	Birmingham Dis. Bone and Potash	B'ham. Fért. Co., Birmingham, Ala.	9.90	3.78	.42	.99	1.84	17.79
6270	B'ham H. G. Blood, Bone & Potash	" " "	10.35	3.63	.32	1.84	2.52	21.65
6271	Birmingham Soluble Guano	" " "	9.80	4.48	.42	1.80	1.31	20.91
6272	Birmingham Standard Grade Fert.	" " "	9.75	4.25	.40	1.80	1.18	20.22
6275	Guano	G. W. McKing, Five Points, Ala.	5.75	1.68	3.22	1.74	1.97	14.27
6278	Guano	W. L. Patterson, Oswichee, Ala.	8.45	2.50	.70	1.98	1.57	18.08
6279	Fertilizer	W. L. Cosby, Walnut Hill, Ala.	7.80	2.42	.28	1.40	2.72	16.86
6282	Patasco Guano	O. J. Belcher, Headland, Ala.	8.75	2.93	1.82	.94	1.00	15.31
6291	Grays H. G. Guano	Dadeville Oil Mill, Dadeville, Ala.	7.70	2.78	.22	1.58	1.79	16.64
6292	Stone & Johnston's H. G. Guano	" " "	7.90	2.79	.26	1.58	1.92	17.03
6293	Home Mixture Guano	" " "	7.80	1.91	.44	1.50	2.20	16.11
6297	Guano	S. M. Day, Five Points, Ala.	6.60	5.00	6.60	1.46	.75	16.44



## Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued

Station No.	NAME OF FERTILIZER.	BY WHOM SENT.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
6296	Goldsmith's Improved Mixture. . .	Prim & Kimbel, Jackson, Ala. . . . .	8.60	3.12	2.68		2.00	2.78	20.05
6303	Aurora. . . . .	Herren & Oliver, Dadeville, " . . . .	9.00	3.20	2.25		1.66	1.19	18.04
6304	A. A. P. . . . .	" " " " . . . .	9.30	4.13	2.32		1.00	1.45	17.68
6305	Coweta H. G. Guano . . . . .	" " " " . . . .	9.20	2.35	2.60		1.80	2.29	18.84
6306	W. O. O . . . . .	" " " " . . . .	8.45	3.48	3.32		1.80	2.85	19.32
6313	Blood, Bone and Potash . . . . .	McGhee, Driver & Co., Lafayette, Ala. . .	5.65	5.21	4.14		1.60	1.24	16.58
6314	Mastodon . . . . .	" " " " . . . .	8.70	2.44	1.86		1.44	2.18	17.85
6317	H. G. Potash Guano. . . . .	R. A. Russell & Co., Gaylesville, " . . .	6.00	3.92	2.18		1.84	2.07	15.74
6318	Blood and Bone Guano . . . . .	" " " " . . . .	7.00	4.39	2.08		1.16	1.07	15.71
6325	Capital City Standard Guano. . . . .	Wright, Henderson & Co., Elba, " . . .	6.05	4.07	4.08		1.64	2.32	17.68

8328	Troy Perfect	Wright, Henderson & Co., Elba,	6.85	2.59	8.06	2.20	2.97	16.97
8327	Georgia State Grange Guano	" " "	5.05	3.35	2.80	1.86	2.17	14.98
8331	Georgia State Standard	Sanders & Son, Columbia,	5.75	3.45	4.00	1.86	2.00	16.41
8334	B'ham H. G. Blood, Bone and Potash	Lester & Co., Columblana,	8.50	4.08	1.94	1.34	1.53	17.84
8337	Blood and Bone	H. M. Beech & Son, Columbia,	5.10	4.02	3.08	1.61	1.87	16.20
8338	Complete Cotton Fertilizer	" " "	8.65	1.71	2.24	1.80	2.88	17.78
8339	Jones' Formula	" " "	8.85	3.52	1.98	1.04	3.48	18.76
8340	Excelsior	" " "	8.00	2.10	1.80	1.85	1.59	16.39
8341	Farmer's Special	" " "	6.70	5.74	1.46	1.11	4.82	20.87
8342	Helmet	" " "	3.20	5.69	3.88	1.90	2.42	16.68
8345	Ox Cotton Guano	T. C. Masterson, Avoca,	8.70	4.39	1.28	1.70	1.55	19.40
8347	Armour's 271	C. A. Steifelmeyer, Hanceville,	2.55	7.61	1.34	1.94	1.65	17.54
8348	Meridian Blood and Bone	" " "	8.55	3.88	1.92	1.74	1.59	18.88
8350	Early Bird	Reynolds Bros., Jemison,	8.10	3.75	6.20	1.24	1.64	16.96
8353	Georgia Formula Guano	Campbell & Wright, Jr., Roanoke,	8.85	2.40	2.60	1.72	2.24	18.81
8354	Georgia State Grange Guano	" " "	7.90	2.13	.94	1.65	3.85	18.01
8355	Pos Pon Crop Grower	" " "	8.50	2.04	2.58	1.22	2.94	16.90
8356	Randolph Guano	" " "	5.50	2.58	1.92	2.54	2.29	17.48

# Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued.

Station No.	NAME OF FERTILIZER.	By Whom Sent.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
6257	Roanoke Guano.....	Campbell & Wright, Jr., Roanoke, Ala.	7.25	2.45	2.70	1.96	1.41	\$16.65	
6367	Roanoke Food, Bone and Potash .....	S. E. Stewart, Hartselle, Ala .....	7.50	2.80	3.40	1.50	1.78	16.26	
6358	Alabama Guano.....	" " " .....	7.50	2.81	2.04	1.98	2.06	17.71	
6369	Adair's Am. Dis. Bone .....	" " " .....	7.00	1.94	2.86	1.88	2.38	16.26	
6370	Ga. State Grange Fertilizer.....	" " " .....	8.10	1.73	3.02	1.54	2.85	16.99	
6371	Ox Cotton Guano .....	" " " .....	8.95	3.84	1.86	1.56	1.74	19.90	
6373	Read's H. G. Am. Dis. Bone.....	" " " .....	8.40	3.97	1.48	.72	2.90	17.29	
6374	Sample No. 1 .....	C. R. Maxwell, Northport, " .....	8.75	.90	.40	1.22	2.86	15.37	
6375	Sample No. 2 .....	" " " .....	19.00	1.44	.86	1.16	2.76	17.45	
6377	Helmet Brand Potato Fertilizer...	S. F. Alston, Tuscaloosa, Ala .....	2.90	9.48	2.24	8.72	4.22	26.40	

6378	Helmet Brand Blood, Bone & Potash	S. F. Alston, Tuscaloosa, Ala.	2.25	9.18	1.62	4.18	10.40	33.53
6379	Helmet Brand 271	" " "	1.85	8.11	1.14	2.14	1.74	17.68
6380	Helmet Brand 383	" " "	3.30	8.64	2.06	2.50	7.55	26.49
6383	King Cotton Grower	W. D. Hamilton, Guin, Ala.	6.75	4.19	5.26	.60	1.28	13.91
6385	Scott's Gossypium Phospho.	O. A. Steifelmeier, Cullman, Ala.	9.90	1.71	1.24	1.88	8.26	20.18
6387	B'ham Blood, Bone and Potash	" " "	8.40	3.81	1.64	1.45	2.13	18.40
6389	Bone Compound	" " "	7.25	2.90	6.20	1.60	2.07	16.70
6390	Standard Home Mixture	" " "	7.45	3.82	1.08	1.62	2.90	18.71
6391	Helmet Brand 271	" " "	2.00	7.73	1.52	2.12	2.09	17.79
6394	Ga. State Standard Superphosphate	Law & Davis, Lincoln, Ala.	6.25	3.91	2.44	1.68	3.32	18.13
6395	Scott's Gossypium Phospho.	" " "	7.40	4.79	.96	1.86	3.20	20.80
6396	Scott's Blood Formula	" " "	7.15	4.37	2.08	1.10	2.25	16.85
6399	W. O. C.	S. F. Teague, Birmingham, Ala.	6.30	2.86	3.32	1.58	2.64	17.34
6400	Teague's Beef, Blood and Bone	" " "	6.55	3.53	4.02	1.04	2.07	15.08
6402	Animal Ammoniated	T. H. & A. B. Stephens, Saraborn, Ala.	7.05	2.87	3.63	1.74	1.68	16.47
6403	Blood Formula	" " "	9.45	3.13	2.12	1.08	1.86	17.46
6405	B'ham H. G. Fertilizer	F. Ogden & Son, Sulligent, Ala.	8.35	3.96	.72	1.54	2.79	19.42
6406	Mobile Standard Guano	" " "	5.50	3.97	6.03	1.82	3.42	18.15

# Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATES WITH NITROGEN AND POTASH

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
8408	Ox Cotton Guano.....	Porter & Foster, Town Creek, Ala.....	7.85	4.17	1.88	1.72	2.51	\$19.85
8410	Blood & Bone.....	J. B. Gray & W. W. Gullledge, Ohatchie	7.10	2.86	3.44	1.19	1.99	15.28
8412	Read's Blood & Bone No. 1.....	F. R. Parish & Bros., Clayton, Ala.....	7.26	3.93	1.42	1.30	2.53	17.35
8415	Aurora Am. Phosphate.....	Jas E. Sneed, Sneed, Ala.....	5.85	3.32	1.38	1.64	1.93	15.96
8418	Animal Bone Fertilizer.....	" " " ".....	7.20	4.00	6.10	1.75	1.74	17.88
8419	A. A. P. Bone with Ammonia.....	" " " ".....	7.35	4.51	1.14	1.35	1.46	17.10
8420	W. O. C. Guano.....	" " " ".....	8.30	4.47	1.48	2.22	2.62	21.41
8421	Sea Bird Guano.....	" " " ".....	7.90	2.98	6.82	1.64	2.22	17.64
8422	Coweta H. G. Fertilizer.....	" " " ".....	8.30	5.51	5.44	1.72	1.95	20.88
8424	Sea Gull Compound.....	R. W. Allen & Co., LaFayette, Ala.....	8.00	2.75	2.30	1.00	2.84	15.89

6428 Georgia Formula.....	R. W. Allen & Co., LaFayette, Ala.....	7.70	8.07	2.18	1.44	2.40	17.90
6428 Am. Dis. l'one. ....	J. R. G. Howell, Dothan, Ala.....	7.70	8.41	1.84	.98	2.89	18.84
6429 Howell's Fruit Food.....	.. .. .	4.25	3.88	.82	3.16	3.81	19.79
6431 Beef, Blood & Bone Guano.....	Weather's, Swan & Co., Roanoke, Ala.....	7.90	8.45	1.80	1.12	1.28	15.72
6432 Solid South Guano.....	.. .. .	7.90	8.30	3.00	1.58	2.24	17.98
6434 Tuscaloosa Guano.....	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala	8.30	8.54	.28	2.16	2.86	20.25
6436 Goulding's Bone Compound .....	Hughes Bros., Florals, Ala.....	6.90	4.08	5.32	1.48	2.05	17.17
6438 Potapco Guano.....	R. W. Allen & Co., LaFayette, Ala.....	8.55	2.89	1.96	1.36	2.32	17.57
6445 Hume's Am. Dis. Bone.....	Troy Fertilizer Co., Troy, Ala.....	8.45	8.13	2.42	1.68	2.32	18.60
6447 Troy Perfect Guano.....	.. .. .	7.80	8.32	2.68	1.48	2.11	17.37
6448 Blood and Bone Guano.....	.. .. .	8.05	8.68	2.32	1.62	2.34	18.56
6449 .. .. .	.. .. .	8.55	2.77	2.18	1.64	2.57	18.48
6453 Complete Cotton Fertilizer.....	P. J. Ham & Son, Elba, Ala.....	7.85	1.88	3.22	2.00	2.4	17.70
6454 Jones Special Formula.....	.. .. .	8.35	2.65	1.50	1.22	4.02	18.54
6455 Merriman's Cotton Boll Guano.....	.. .. .	9.95	1.38	2.32	1.58	4.67	19.82
6456 .. .. .	.. .. .	10.05	1.46	1.94	1.34	3.33	18.59
6459 Blood, Bone and Potash.....	Hilton, Bentley & Cosby, Brantley, Ala.	10.00	2.53	1.72	.94	1.69	16.85
6460 Ga. State Grange Fertilizer.....	.. .. .	6.10	2.84	2.56	1.68	2.93	16.57

Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.  
ACID PHOSPHATES WITH NITROGEN AND POTASH.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6481	Jones Special Formula .....	Hilton. Bentley & Cosby. Bentley, Ala.	7.40	3.25	3.10	.95	3.88	17.19
6462	Sample No. 1 .....	C. Kimbrough, Alexander City, Ala. ....	8.20	3.86	1.94	2.06	2.88	20.21
6463	Sample No. 2 .....	.....	7.05	3.12	1.38	2.43	1.58	18.50
6468	Troy Perfect Guano .....	J. T. Ramage, Brundidge, Ala. ....	7.55	2.79	3.26	1.94	2.65	18.42
6469	Star Guano. ....	.....	6.75	3.53	5.22	2.28	1.55	18.21
6470	Sea Gull Guano .....	.....	7.00	5.25	4.10	1.84	2.68	20.06
6472	Blood Bone and Potash .....	W. F. Kenzie, Greenville, Ala. ....	6.00	4.98	5.22	1.98	2.13	18.60
6473	Goulding's Special Compound .....	.....	7.05	3.07	7.08	1.56	2.90	17.89
6476	Alabama Guano .....	J. O. Akin & Son, Notasulga, Ala. ....	7.10	3.77	1.28	2.16	2.86	19.28
6478	Ammo. Superphosphate .....	First Bank of Elba, Elba, Ala. ....	5.55	3.56	2.80	1.42	2.43	15.41

6479	Hume's Am. Dis. Bone	First Bank of Elba, Elba, Ala	7.85	2.31	4.44	1.24	2.02	15.65
6481	Patapoco Guano	F. K. Brantley & Son, Troy, Ala.	8.00	3.14	1.96	.94	2.50	16.27
6482	Sea Gull Guano	" " "	9.45	1.28	2.12	.96	2.53	15.95
6485	Baltimore Soluble Bone	J. G. & John Sanders, Dothan, Ala	8.80	3.89	1.46	.51	1.57	13.76
6493	Georgia Formula	C. H. Butler, Childersburg, Ala	7.55	2.44	2.28	1.41	2.62	16.56
6495	Georgia State Grange	Burks & Coston, Brantley, Ala	7.20	2.47	.98	2.30	2.78	18.89
6497	Ox Cotton Grower	M. F. Patterson, Falkville, Ala	7.80	3.95	2.50	2.16	2.02	19.82
6498	Troy Perfect	Burks & Coston, Brantley, Ala	7.70	2.07	2.28	1.62	2.29	16.60
6499	Blood and Bone	" " "	4.80	4.22	4.28	1.88	1.88	14.71
6502	Perfection Guano	McMillan & Harrison, Mobile, Ala	7.50	3.06	.74	2.64	3.57	21.82
6503	" "	Jess Jackson, Grand Bay, Ala	10.55	2.56	1.34	1.48	3.34	20.59
6505	Gossypium Phospho	W. S. Crass, Pelham, Ala	9.30	2.37	.78	1.54	2.71	18.69
6508	Big Hit	G. A. Sanders, Luverne, Ala	11.85	1.68	2.02	1.22	1.06	17.51
6509	Hume's Am. Dis. Bone	" " "	7.85	1.58	3.42	1.68	2.34	16.47
6513	Roanoke Guano	A. J. Pittman, Wehodkee, Ala	7.85	2.67	3.06	1.86	2.24	17.47
6514	Randolph Guano	" " "	7.80	3.60	2.80	1.88	2.14	18.16
6516	Beef, Blood and Bone	W. A. Gage & Co., Town Creek, Ala	8.65	4.15	1.30	1.80	2.21	19.06
6517	Helmet 232	" " "	2.90	8.92	.96	2.06	3.25	20.62



Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.  
ACID PHOSPHATES WITH NITROGEN AND POTASH.

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6518	Helmet, 271.....	W. A. Gage & Co., Towne Creek, Ala....	2.50	9.10	1.00	2.14	2.42	20 01
6521	Old Dominion.....	Phillips Bros, Oxford, Ala.....	4.06	4.80	2.20	1.92	8.24	17 27
6522	Talladega Am. Dis. Bone.....	" " ".....	6.65	3.00	0.20	2.06	8.88	18 80
6524	Ga. State Standard Guano....	Ingram & Co., Anniston, Ala.....	8.65	2.71	1.41	1.56	2.18	17 98
6527	Eddystone Soluble Guano.....	J. Markentepe, Cullman, Ala.....	6.75	4.24	2.66	2.10	1.80	17 67
6528	Fertilizer.....	Robbins & McGowan, Brewton, Ala....	8.95	2.05	2.80	2.18	2.36	19 46
6532	Schuessler & Co's Beef Blood & Bone	Schuessler & Co., Roanoke, Ala.....	7.25	3.41	6.24	1.28	1.52	15 71
6533	" " Special Formula.....	" " ".....	7.45	3.34	4.46	1.26	4.26	18 57
6534	" H. G. Fertilizer.....	" " ".....	6.75	3.35	4.90	1.80	2.65	18 07
6538	Ala. Fertilizer.....	Britt & Johnson, Wetumpka, Ala.....	8.60	4.99	.56	2.10	2.80	22 07

6541	Hume's Am. Dis. Bone.....	McEntyre, Henderson & Adams, Ozark.	7.80	2.85	2.20	1.92	2.80	18.48
6543	Troy Perfect Guano.....	" " "	6.70	2.94	3.69	1.26	3.28	15.85
6544	Goldsmith's Improved Mixture.....	" " "	6.15	3.65	2.10	1.67	1.96	16.44
6545	Swift's Eagle.....	" " "	7.10	4.98	1.02	2.02	2.87	20.56
6547	Am. Dis. Bone.....	B. Bullard, Elba, Ala.....	6.60	5.98	4.96	1.16	1.20	17.04
65	Crescent Guano.....	" " "	6.50	9.08	0.62	1.62	1.01	21.18
6550	XXX Blood & Bone Guano.....	George Kroell, Montevallo, Ala.....	8.00	3.66	2.24	1.54	1.60	17.57
6552	Farmers Alliance Guano.....	H. R. & H., Brantley, Ala.....	7.40	2.89	3.26	1.84	2.29	17.75
6553	Nancy Hanks Guano.....	" " "	7.60	2.17	2.18	1.62	2.51	17.86
6554	Hume's Am. Dis. Bone.....	" " "	7.20	2.89	2.46	2.10	2.81	18.28
6555	Troy Perfect.....	" " "	7.90	2.67	3.08	1.94	2.12	18.12
6556	B. D. Sea Fowl Guano.....	" " "	8.40	2.96	2.82	2.04	1.85	18.44
6557	Capital City Guano.....	" " "	6.80	3.76	4.44	1.82	2.57	18.28
6461	B'ham Blood, Bone and Potash...	Geo. M. Truss & Co., Springville, Ala...	9.70	3.65	1.80	1.66	2.80	20.30
6563	Fertilizer.....	J. O. Hodges, Ashville, Ala.....	8.10	3.52	1.98	1.68	2.85	19.17
6565	Bear Beef, Blood and Bone.....	A. P. Howison, Randolph, Ala.....	7.60	4.58	2.02	2.28	2.47	21.08
6570	Ox Slaughter House Bone.....	W. W. Carlisle & Bro., Roanoke, Ala.....	7.40	4.52	1.18	1.56	2.77	19.06
6573	Blood and Bone Guano.....	" " "	4.69	5.13	1.42	1.70	2.75	17.24

# Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

## ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6574	Roanoke Guano.....	W. W. Carlisle & Bro. Roanoke, Ala...	5.55	4.44	2.66	2.04	1.79	17.49
6575	Randolph Fertilizer.....	" " " "	6.85	3.91	2.24	2.00	2.03	18.39
6579	Alabama Fertilizer.....	Sessions & Mizelle, Enterprise, Ala....	6.75	5.52	1.88	1.88	1.69	19.07
6582	Helmet 271.....	F. A. Howle, Oxford, Ala.....	2.00	8.84	.66	1.98	1.67	18.05
6583	Georgia State Grange Guano.....	" " " "	7.45	2.50	1.80	1.70	2.61	17.82
6584	Birmingham Guano.....	" " " "	4.85	4.17	1.48	1.14	1.75	18.98
6588	Tip Top.....	T. J. Land, Cullman, Ala.....	9.65	2.83	2.82	1.02	1.27	16.61
6590	Stern's Am. Raw Bone.....	Chapman & Co., Geneva, Ala.....	4.30	3.60	4.40	1.52	1.66	16.92
6501	Champion Farmers' Choice.....	" " " "	6.80	3.07	.88	2.14	1.84	17.50
6594	No. 8 Wet Guano.....	J. S. Collins, Geneva, Ala.....	7.85	5.24	1.86	1.44	1.70	18.82

6597	Mobile Standard.....	Crutcher & Ward, Cuba, Ala.....	5.40	5.10	6.40	1.65	2.24	17.86
6598	Helmet Brand.....	M. P. White, Attalla, Ala.....	1.45	8.97	.58	2.26	1.87	18.62
6601	Scott's Animal Am. Dis. Bone.....	W. J. Sibert, Gadsden, Ala.....	7.50	2.98	2.82	1.64	1.55	16.62
6603	Mobile Standard Guano.....	Chas. Ivey, Evergreen, Ala.....	5.65	4.60	6.10	1.72	2.11	17.18
6605	Blood and Bone.....	Zena Shepherd, Georgiana, Ala.....	6.45	3.64	4.16	1.51	2.15	16.47
6608	Alliance Soluble Guano.....	J. I. Covington, Bertha, Ala.....	6.50	4.27	3.88	1.78	2.01	17.76
6609	Rock City.....	J. E. F. Westmoreland, Florence, Ala.....	6.95	3.48	1.12	1.50	1.75	16.88
6610	Pacific Guano.....	" " " ".....	7.40	4.28	5.02	1.18	1.84	16.77
6611	Armour's 722.....	J. A. Kenney, Loop, Ala.....	4.05	9.47	4.28	1.48	2.22	19.88
6616	Corn and Cotton Guano.....	J. O. Hartselle & Son, Hartselle, Ala.....	5.55	5.41	4.24	1.14	1.68	16.13
6619	King Cotton Grower.....	W. A. Shaw, Winfield, Ala.....	5.80	4.43	4.12	1.15	2.08	14.98
6621	Crescent Guano.....	C. R. Waxwell, Northport, Ala.....	6.30	3.88	4.12	1.68	1.86	16.24
6622	Maxwells' Home Mixture.....	" " " ".....	6.55	2.78	0.42	1.98	1.97	16.79
6624	Baltimore Soluble Bone.....	Bean & McMurray, Heflin, Ala.....	8.80	4.39	1.26	.55	.....	18.79
6626	Bear, Beef Blood and Bone.....	" " " ".....	7.70	5.14	.86	1.88	2.12	18.82
6631	Ox Cotton Guano.....	Franzen & Olsoo, Thorsby, Ala.....	8.00	4.95	2.10	1.78	1.50	16.88
6633	B'harn Dis Bone Am. and Potash.....	T. U. Crumpton, Maplesville, Ala.....	9.05	4.49	.68	.58	1.59	16.17
6634	Star Brand.....	S. N. Rains, Elba, Ala.....	6.60	4.46	5.34	2.10	1.70	18.64

### ACID PHOSPHATE WITH POTASH—Continued.

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6700	Standard Guano	White & Spiegelner, Goodwater, Ala.	7.00	3.18	0.60	1.88	1.68	16.64
6710	Boss Cotton Grower	" " "	7.10	5.05	2.45	.84	1.98	16.48
6224	B'ham Dis. Bone, Am. & Potash	Birm'ham Fert Co., Birmingham, Ala.	10.00	3.88	.87	.90	1.05	17.40
6225	B'ham H. G. Fertilizer	" " "	10.23	3.85	.87	1.87	2.22	21.04
6225	Cahaba H. G. Fertilizer	" " "	10.23	3.85	.87	1.87	2.22	21.04
6712	Merriman's Cotton Boll Guano	W. C. Perry, Seale, Ala.	5.20	6.55	1.55	1.88	1.82	17.48
6714	Troy Perfect	Ben. Jennings, Seale, Ala.	6.65	2.65	2.90	1.62	1.86	15.10
6717	Eddystone Soluble Guano	W. H. Bynum, Boaz, Ala.	7.30	5.80	2.10	1.44	1.71	18.94
6719	Blood & Bone	J. H. Myers, Langstone, Ala.	7.25	4.15	5.70	.59	1.91	14.98
6720	Patapasco Guano	Bean & McMurry, Heflin, Ala.	8.10	3.85	1.75	.82	2.76	17.01
6724	Blood, Bone & Potash	McEntire, Henderson & Adams, Ozark.	5.80	5.00	5.60	1.98	1.77	17.58
6725	Eddystone Soluble Guano	Elrod & Gibson, Collinsville, Ala.	6.15	5.59	3.08	1.94	1.53	18.70
6728	No. 1 Guano	W. H. Mizelle, Grimes, Ala.	6.80	1.89	3.08	1.46	2.08	14.64
6727	No. 3 Guano	" " "	7.15	4.79	1.36	2.12	2.08	19.91
6730	Magnet Soluble Guano	Davis, Marshall & Co., Mobile, Ala.	6.70	4.55	1.85	2.20	2.18	19.54
6734	Beef, Blood & Bone	R. F. Gilbert, Porterville, Ala.	6.65	5.43	1.22	.73	1.58	15.65
6735	Magic Cotton Grower	" " "	5.80	6.11	1.44	.90	2.01	16.54
6738	Alabama Guano	Gunter & Ealem, Gantt, Ala.	6.50	3.54	3.16	1.88	1.90	17.20



# Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATES WITH POTASH.

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6739	Old Homestead .....	Gunter & Ealem, Gantt, Ala .....	8.45	8.60	8.10	1.00	2.29	\$17 13
6740	Meal Mixture .....	" " " .....	6.10	8.90	2.10	1.88	2.06	17 30
6741	Pike Pride .....	" " " .....	7.60	8.56	1.04	1.54	2.27	17 74
6744	Cow Guano .....	McEntire Bros., Cullman, Ala .....	5.70	8.08	5.02	1.78	2.20	15 91
6745	Corn and Cotton Guano .....	" " " .....	8.10	.88	5.72	.74	2.26	13 26
6747	Blood and Bone (Guano) .....	S. W. Henry, Springville, " .....	6.00	4.48	4.82	.86	2.09	14 83
6748	Fertilizer .....	J. C. Alford & Son, Childersburg, Ala .....	6.75	6.57	2.98	1.68	1.77	19 74
6751	Farmer's Special Manure .....	R. Q. Edmonson & Bros., Eufaula, Ala .....	7.45	4.80	1.10	.74	2.81	17 23
6753	282 .....	F. L. Johnson & Co., Gadsden, Ala .....	2 25	7.60	2.35	2.10	2.18	17 91
6754	Complete Fertilizer .....	E. J. Neher, Hollywood, Ala .....	4.60	4.50	4.80	.80	2.18	18 74



**Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.**  
**ACID PHOSPHATES WITH NITROGEN AND POTASH—Continued.**

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6794	Southern Pacific Guano.....	Montgomery Fertilizer Co., Montgomery.	7.35	8.33	5.82	1.26	1.56	15.77
6795	Plow Brand Soluble Guano.....	" " "	7.25	4.52	4.28	1.21	1.50	16.66
6796	Tariff Reform Soluble Guano.....	" " "	7.70	2.11	5.84	2.26	2.18	18.82
6797	Early Bird Soluble Guano.....	" " "	7.75	3.16	5.24	1.28	1.19	15.68
6798	Our Cotton Queen Guano.....	" " "	6.70	6.82	3.18	1.28	1.80	18.90
6799	Capital City Standard Guano..	" " "	7.50	3.83	4.92	2.28	2.74	20.45
6800	Willson's Special Compound.....	" " "	8.80	3.74	3.96	1.52	1.67	17.97
6802	Planters Pride Guano.....	West & McMurray, Roanoke, Ala.....	6.95	3.27	2.98	1.55	2.11	16.67
6805	Sea Gull Soluble Guano.....	Montgomery Fertilizer Co., Montgomery.	7.70	3.38	4.62	2.24	2.55	19.85
6806	Crescent Guano.....	" " "	7.55	3.27	4.68	2.08	1.52	18.09

6807	Clayton Fertilizer.....	Montgomery Fertilizer Co., Montgom'y.	5.50	3.66	.94	2.40	3.41	19.89
6813	Am. Dis. Bone.....	O. W. Bell & Son, Lineville, Ala.....	9.20	.54	8.86	1.92	2.87	17.49
6817	Baltimore Soluble Bone.....	G. W. Roberts & Co., Collinsville, Ala...	7.90	4.11	1.54	1.14	1.85	17.05
6818	H. G. Patapasco Guano.....	" " " "	9.20	3.06	1.84	1.40	1.78	17.96
6814	Blood, Bone and Potash.....	O. W. Bell & Son, Lineville, Ala.....	5.80	6.80	7.80	.08	2.01	14.83
6819	Alabama Fertilizer.....	W. A. Arnold, Ozark, Ala.....	8.60	2.40	1.80	1.92	1.7	18.15
6820	Dale County Standard.....	" " " "	8.70	3.91	.74	2.80	1.97	21.12
6822	Solid South Guano.....	Reeves, Sanders & Co., Heflin, Ala.....	6.55	3.73	2.92	1.54	1.92	16.71
6823	Am. Dis. Bone.....	W. F. Vandiver & Co., Montgomery, Ala.	7.15	3.87	5.08	1.48	1.74	16.78
6825	Helmet Brand 271.....	F. E. King & Co., Leighton, Ala.....	1.55	10.10	.60	2.04	1.47	18.83
6826	Alliance Soluble Guano.....	J. C. Pinkston, Shorter, Ala.....	6.60	3.64	5.06	1.76	2.01	17.02
6829	Goulding's Bone Compound.....	F. A. Gullledge, Verbena, Ala.....	6.20	4.22	4.28	1.29	2.85	16.88
6833	Patapasco Am. Dis. Bone.....	White & Aubry, Roanoke, Ala.....	7.10	3.44	2.86	1.78	2.02	17.54
6834	Patapasco H. G. Guano.....	" " " "	8.65	2.91	1.94	1.28	2.06	16.22
6835	Sea Bird Guano.....	" " " "	7.20	4.67	1.78	1.68	2.84	18.81
6836	Sea Gull Guano.....	" " " "	8.85	1.58	2.22	1.84	1.89	15.52
6837	W. O. O. Pure Blood Guano.....	" " " "	6.75	4.37	1.48	1.74	2.13	18.02
6839	Bear Beef, Blood and Bone.....	A. B. Vandigrift & Son, B'ham, Ala.....	7.70	4.78	1.62	1.68	2.67	19.85

**Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.**  
**ACID PHOSPHATES WITH NITROGEN AND POTASH.**

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
6840	Helm's Bone, Blood and Potash No. 3	Helm Bone Fertilizer Co., B'ham, Ala.	0.00	6.09	4.86	2.12	2.78	14.81	
6841	Helm's Bone, Blood and Potash No. 4	" " "	0.00	4.29	5.26	1.92	2.18	11.81	
6843	Mobile Standard	E. H. & A. S. Murdock, Coffee Springs.	3.15	5.69	5.16	1.96	2.20	16.53	
6845	Dismond Guano	Cameron Bros, Notasulga, Ala.	5.70	4.66	5.84	1.90	1.88	17.01	
6847	Bear Beef, Blood and Bone	T. L. Neighbors & Bros, Goodwater, Ala.	7.65	3.12	1.88	2.10	2.42	19.07	
6848	Champion Farmers' Choice	R. S. Pilley, Georgiana, Ala.	6.70	3.85	3.90	1.86	2.20	17.96	
6851	Complete Fertilizer	F. E. Oliver, Hyatt, Alabama	0.00	3.90	6.28	1.74	2.76	11.53	
6854	Sea Foul Guano	W. J. Mullins, Clanton, Ala.	7.50	3.83	1.12	1.88	1.72	18.81	
6856	Alabama Fertilizer	" " "	7.85	2.65	1.70	1.88	1.78	17.04	
6857	Magic Cotton Grower	West & McMurry, Roanoke, Ala.	6.90	3.58	1.72	0.90	1.28	14.28	

6860	No. 8 Eddystone Solubio Guano	Montgomery Bros., Lincoln, Ala.	6.80	3.94	.96	2.60	1.83	19.35
6862	Bear, Beef, Blood and Bone	J. T. Tabor, Keener, Ala.	7.70	4.47	.88	2.04	1.74	19.62
6867	Scott's Gossypium Guano	Haley Bros., Haleyville, Ala.	9.06	2.80	2.40	1.92	2.84	19.87
6868	Scott's Blood Formula	" " "	9.50	3.97	1.48	1.02	1.42	17.75
6869	Bear Guano	" " "	8.45	4.85	2.70	2.00	2.13	20.53
6870	Florence King Cotton Guano	" " "	3.90	4.47	5.08	1.44	2.08	14.48
6872	Howle Bros. Bone Compound	Howle Bros., Wetumpka, Ala.	6.80	3.99	6.88	1.74	1.84	17.50
6874	Ozark Guano No. 2	Ozark C. S. O. M. and Fert. Co., Ozark.	6.75	5.99	1.26	2.80	1.63	20.81
6876	Blood, Bone and Potash Guano	E. P. Duncan, Alexander City, Ala.	5.60	5.04	4.76	1.84	1.20	17.59
6877	Georgia State Grange	" " "	5.35	3.40	1.80	1.10	3.48	15.31
6879	New Brand No. 721	J. H. Henderson, Cross Keys, Ala.	4.65	6.49	9.36	1.82	1.04	14.00
6880	Am. Bone	S. J. Baird, Guin, Ala.	9.85	7.11	5.24	0.11	.43	17.70
6882	King Cotton Grower	J. H. Karter Co., Cullman, Ala.	4.80	5.90	5.50	.84	1.42	14.37
6883	Bear Guano	" " "	11.40	5.88	1.22	.04	0.00	17.28
6885	Soluble Guano	T. H. McEntyre, Coffee Springs, Ala.	2.25	7.96	7.50	1.21	1.20	14.79
6889	Eagle Am. Bone	L. O. Cox, Boas, Ala.	6.65	4.26	2.70	1.72	2.82	18.04
6890	Eagle Guano	L. O. Cox, Boas, Ala.	8.10	4.15	2.60	1.90	1.97	19.54
6891	Helmet Brand No. 271	J. H. Henderson, Cross Keys, Ala.	1.90	8.02	.98	2.02	1.80	17.88

# Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.

## ACID PHOSPHATE WITH NITROGEN AND POTASH—Concluded.

Station No.	NAME OF FERTILIZER.	By Whom Sent.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6882	Helmet Brand No. 272 .....	J. H. Henderson, Cross Keys, Ala. ....	2.70	7.88	1.02	2.88	2.81	\$19.55
6883	" " 285 .....	" " " .....	2.00	8.07	2.48	2.00	5.46	24.18
6884	African Cotton Grower 292 .....	" " " .....	2.75	11.09	1.86	2.80	2.92	24.86
6886	Eddystone .....	M. Noble, Avery, Ala. ....	7.80	4.58	1.72	1.82	1.67	18.55
6888	Beef Blood and Bone .....	Reeves, Landers & Co, Heflin, Ala. ....	7.20	4.27	1.98	.98	1.62	15.83
6901	Old Hickory Guano .....	T. B. Williams, Cullman, Ala. ....	7.46	2.86	3.34	1.98	1.76	17.60
6902	Am. Dis. Bone Guano .....	" " " .....	8.15	4.70	5.50	.44	2.28	16.81
6903	Complete Fertilizer .....	J. C. Henaley, " .....	5.70	3.82	4.28	1.58	2.88	16.82
6909	Coley & Sandlin's Special Guano .....	Tallapoosa Oil Co., Alexander City, Ala. ....	6.90	3.50	.50	1.48	2.04	16.58
6910	Cotton Queen Guano .....	" " " .....	5.65	2.72	.78	2.10	2.85	16.60

6911	Standard Guano.....	Tallapoosa Oil Co., Alexander City, Ala.	6.60	8.16	.64	1.52	2.20	16.22
6012	Soluble Guano.....	" " "	6.25	8.86	.54	2.10	2.26	17.75
6918	Waters' Special Guano.....	" " "	6.40	8.10	1.00	1.52	2.13	15.89
6225	Cahaba H. G. Blood, Bone & Potash	Birmingham Fertilizer Co., B'ham, Ala.	10.28	8.85	.87	1.87	2.22	21.04
6225	Earle, Terrell & Co's. H. G. Fert'r..	" " "	10.28	8.35	.37	1.87	2.22	21.04



**Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.**  
**ACID PHOSPHATES WITH POTASH.**

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.			Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
6222	B'ham Acid Phos. & Potash Mixture.	B'ham Fertilizer Co., Birmingham, Ala.	8.80	8.85	0.30	2.18	16.38
6223	B'ham Potash Bone	" " "	7.78	4.92	.56	8.59	16.24
6237	Acid Phosphate & Potash	Troy Fertilizer Co., Troy, Ala.	7.00	1.97	8.66	8.89	12.85
6250	Dis. Bone & Potash	" " "	6.85	1.51	3.64	8.90	12.20
6265	B'ham A. P. & Muriate of Pot. Mixt.	B'ham Fertilizer Co., Birmingham, Ala.	10.40	5.08	.22	2.51	17.94
6266	" " and Potash Mixture	" " "	7.60	6.30	.40	2.26	16.16
6267	B'ham Bone Ash	" " "	9.05	4.27	.88	4.30	17.62
6268	B'ham Potash Bone	" " "	9.40	4.62	.88	4.18	18.15
6278	B'ham Acid Phos. and Potash	" " "	10.20	8.77	.48	1.41	15.88
6280	Acid Phosphate and Potash	W. Andrews, LaFayette, Ala.	8.25	3.82	.58	4.41	16.38

6295	.. .. .	W. Andrews, LaFayette, Ala. ....	8.20	8.88	.72	4.89	16.92
6299	Coweta Dia. Bone & Potash .....	Herran & Oliver, Dadeville, Ala. ....	12.45	8.48	.62	1.98	17.86
6300	.. .. .	.. .. .	6.95	4.98	2.12	3.18	15.06
6301	.. H. G. Dia. Bone & Potash .....	.. .. .	11.25	8.09	.56	2.18	16.47
6302	Coweta Standard .....	.. .. .	9.00	8.52	.58	4.28	16.80
6310	Acid Phos. & 4% Potash .....	McGhee, Driver & Co., LaFayette, Ala. ....	.65	9.00	1.50	4.56	14.21
6311	Dia. Bone & Potash .....	.. .. .	7.60	5.83	3.12	1.84	14.77
6312	Bone & Potash .....	.. .. .	10.20	5.44	1.86	1.09	16.78
6315	Stone Acid & Potash .....	R. A. Russell & Co., Gaylesville, Ala. ....	5.15	9.36	1.14	2.49	18.00
6324	Bone & Potash Phosphate .....	Wright, Henderson & Co., Elba, Ala. ....	8.75	2.86	1.54	3.39	14.51
6329	Dixie Acid Phos. & Potash .....	Jno. A. Nicholls, Childersburg, Ala. ....	6.80	6.98	.52	2.41	15.69
6330	Cahaba Acid Phos. & Potash .....	.. .. .	10.25	4.88	.52	1.26	16.84
6333	B'ham Acid Phos. & Potash Mixture .....	Lester & Co., Columbiana, Ala. ....	9.45	4.45	1.00	1.01	14.91
6336	8 and 4 .....	H. M. Beach & Son, Columbia, Ala. ....	8.55	1.99	.86	4.87	15.41
6344	Bone & Potash .....	T. C. Masterson, Arooa, Ala. ....	9.50	6.19	3.02	.24	15.92
6349	Marietta Guano Co's H. G. Dia. Bone .....	Reynolds Bros., Jemison, Ala. ....	8.30	4.01	1.64	2.21	14.52
6351	Bone & Potash Acid .....	Campbell & Wright, Jr., Roanoke, Ala. ....	9.60	2.01	3.44	2.17	18.78
6352	Potash Acid .....	.. .. .	8.95	2.37	3.68	2.52	18.84



6452	Ga. Bone Compound	P. J. Ham & Son, Elbe, Ala.	7.35	3.09	.56	3.75	14.79
6458	Bone and Potash Acid Phosphate	Hilton, Bentley & Cosby, Brantley, Ala.	11.65	1.17	.78	2.83	15.65
6475	Opelika Phosphate and 2% Potash	J. C. Akin & Son, Notasulga, Ala.	6.25	4.91	5.14	2.05	13.21
6480	Pataasco Phosphate	T. K. Brantley & Son, Troy, Ala.	10.50	3.12	1.08	1.91	15.53
6483	" 1% Potash	J. G. & John Sanders, Dothan, Ala.	9.90	3.35	2.00	1.97	15.22
6484	acid Phosphate with 4% Potash	" " "	1.80	7.49	1.28	5.98	15.15
6489	Acid Phosphate and Potash	First Bank of Elbe, Elbe, Ala.	7.90	3.28	2.12	3.43	14.61
6490	B'ham Dis. Bone and Potash	C. H. Butler, Childersburg, Ala.	9.30	2.78	1.74	1.03	13.14
6491	Acid Phosphate and Potash	" " "	10.20	3.31	2.04	1.66	15.17
6492	B'ham Acid Phos. and Potash	" " "	11.05	2.37	.68	2.32	15.74
6510	"Guano"	W. A. Sims, Elrath, Ala.	1.45	8.78	1.94	1.14	11.35
6512	Potash Acid	A. J. Pittman, Wehodkee, Ala.	8.00	4.18	1.02	2.51	14.75
6520	Dis. Bone and Potash	Phillips Bros., Oxford, Ala.	8.05	5.84	.86	3.86	17.75
6525	Tenn. Special Wheat Grower	Ingram & Co., Anniston, Ala.	1.45	10.20	1.90	6.08	17.68
6531	S. & Co's H. G. Bone and Potash	Scheussler & Co., Roanoke, Ala.	5.05	4.79	5.98	1.97	11.81
6535	Sample No 1	W. W. Hicks & Co., Dadeville, Ala.	7.85	4.99	1.66	1.77	14.64
6536	Bear Brand Potash Mixture	Britt & Johnson, Wetumpka, Ala.	5.80	5.25	5.60	3.49	14.54
6540	Dis. Bone and Potash	McEntyre, Henderson & Adams, Ozark	9.00	3.47	1.68	4.08	18.55

## Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

## ACID PHOSPHATE WITH POTASH—Continued.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.				Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6542	Dis. Bone and Potash.....	McEntyre, Henderson & Adams, Ozark..	8.80	5.97	2.18	4.11	\$18.68	
6559	B'ham Acid Phos and Potash Mixture..	Geo. M. Truss, Springville, Ala.....	10.75	6.28	.32	2.64	19.67	
6560	B'ham Acid Phos with Potash.....	.. .. .	12.00	3.21	.44	2.35	17.56	
6571	Bone and Potash Mixture.....	M. W. Carlisle & Bro., Roanoke, Ala.....	5.55	6.04	3.56	1.77	13.86	
7572	Ox Potash Mixture.....	.. .. .	7.80	4.75	6.00	2.22	14.27	
6577	Ac'd Phos with Potash.....	Sessions & Mizell, Enterprise, Ala.....	4.35	5.45	4.50	3.75	13.55	
6578	Alkaline Bone with 2% Potash.....	.. .. .	6.50	4.80	4.86	3.07	14.87	
6581	Bone and Potash.....	T. A. Howle & Co., Oxford, Ala.....	8.95	4.43	.72	2.21	15.59	
6607	Phosphate 2% Potash .....	J. I. Covington, Bertha, Ala.....	5.80	5.82	1.68	2.19	13.81	
6618	"Complete Fertilizer" .....	Burns & Beaver, Lincoln, Ala.....	7.80	3.97	4.78	2.19	13.96	

6617	Tiger Brand Guano.....	J. O. Hartselle & Son, Hartselle, Ala.....	4.85	6.12	4.78	2.48	18.45
6626	Bear Bone and Potash.....	Bean & McMurray, Heflin, Ala.....	4.45	7.00	6.90	2.12	13.57
6628	Eddystone Bone and Potash.....	Elsod & Gibson, Collinsville, Ala.....	10.15	6.82	1.98	1.56	18.08
6635	Scott's H. G. [and Potash] .....	Lull & Lacey, Wetumpka, Ala.....	6.95	5.00	.68	2.22	14.19
6637	Pure Dis. Bone and Potash.....	.. ..	9.80	2.80	.90	1.52	14.22
6683	No. 1 .. ..	Trawick & Jernigan, Opelika, Ala.....	8.85	4.84	2.96	2.45	14.54
6684	No. 2 .. ..	.. ..	8.80	3.75	3.30	2.88	14.93
6685	No. 3 .. ..	.. ..	8.70	3.96	3.74	3.52	16.18
6695	Maricotta H. G. Acid Phos. and Potash.....	Coley & Sandlin, Alexander City, Ala.....	6.20	4.70	1.65	2.31	13.21
6696	Water's H. G. Dis. Bone and Potash.....	.. ..	4.00	4.25	.90	2.23	10.48
6699	Cotton Queen .....	.. ..	6.00	4.80	2.00	2.00	12.80
6705	Cahaba Acid Phos. and Potash Mixture.....	White & Speigner, Goodwater, Ala.....	12.75	4.20	.70	1.71	18.66
6713	Dis. Bone and Potash.....	Ben. Jennings, Seale, Ala.....	7.95	3.45	1.10	3.34	14.74
6716	Eddystone Bone and Potash.....	W. H. Bynum, Boaz, Ala.....	4.40	7.40	5.50	2.13	13.93
6723	"Guano", .....	J. I. Brewer, Tabor, Ala.....	9.90	3.40	2.20	1.48	14.75
6728	No. 1.....	J. E. Smith, Stroud, Ala.....	4.95	7.39	.76	2.21	14.55
6733	Dis. Bone with Potash.....	R. F. Gilbert, Porterville, Ala.....	5.75	6.89	.56	1.56	13.70
6737	Dis. Bone and Potash.....	Gunter & Ealam, Gantt, Ala.....	6.50	8.94	3.46	2.73	13.17

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901  
ACID PHOSPHATE WITH POTASH.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Potash.	Commercial Value
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
6750	Special Potash Mixture.....	R. Q. Edmonson & Bro., Enfaule, Ala....	5.00	4.92	4.08	4.12	14.04
6752	No. 10—4's. ....	T. L. Johnson & Co., Gadsden, Ala. ....	6.70	5.18	2.42	9.87	15.20
6763	Opelika Acid Phos. & 2% Potash.....	Opelika Chemical Co., Opelika, Ala. ....	6.85	6.06	2.28	2.17	15.09
6764	Potash Acid Phosphate.....	.. .. .	7.75	6.95	1.80	2.02	16.72
6765	Schuessler Bro's H. G. Bone & Potash..	.. .. .	7.00	5.25	2.50	2.28	14.44
6766	.. .. XXX ..	.. .. .	9.20	6.18	2.41	1.72	16.10
6767	.. & Co's H. G. ..	.. .. .	7.00	4.40	2.80	2.41	14.11
6768	English Acid Phos, with 2% Potash.....	Montgomery Fertilizer Co., Mont'gy, Ala.	6.95	6.83	2.42	2.84	15.62
6769	Montgomery Acid Phos. and Potash.....	.. .. .	6.50	5.89	2.46	2.87	14.76
6790	Dis. Bone and Potash. ....	.. .. .	7.75	6.95	2.89	1.18	15.88

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6804	Alkaline Acid Phos. 4% Potash.....	Montgomery Fertilizer Co., Mont'gy, Ala.	5.85	3.78	1.92	4.08	13.49
6816	4% Acid Phosphate.....	G. W. Roberts & Co., Collinsville, Ala...	.90	5.75	.80	4.25	10.90
6831	Potash Acid.....	White & Aubrey, Roanoke, Ala.....	11.90	2.70	1.80	1.64	16.24
6832	Pa'apaco Bone & Potash.....	.. .. .	7.00	4.20	1.50	2.67	14.87
6853	B'ham Potash Mixture.....	W. J. Mullins, Clanton, Ala.....	8.15	4.86	.64	2.02	16.08
6859	No. 1 Eddystone Bone & Potash.....	Montgomery Bros., Lincoln, Ala.....	6.45	5.95	4.70	1.86	14.26
6863	Adair's Formula.....	Jno. T. Tabor, Keener, Ala.....	6.85	6.31	1.84	2.22	15.88
6878	Howie Bros' Phos. & Potash.....	Howie Bros., Wetumpka, Ala.....	10.05	5.18	2.12	1.16	16.81
6888	Eagle Dis. Bone & Potash.....	L. O. Cox, Boaz, Ala.....	5.75	6.50	5.50	1.00	13.25
6900	H. G. Bone & Potash.....	T. B. Williams, Cullman, Ala.....	8.50	4.86	7.14	1.59	12.75
6906	Tallapoosa Dis Bone and Potash.....	Tallapoosa Oil Co., Alex. City, Ala.....	7.75	4.85	.70	2.00	14.60
6907	Our Best Fertilizer Bone and Potash.....	.. .. .	7.60	4.75	0.40	1.68	14.08
6908	Coley & Sandlin's Special Bone & Potash.....	.. .. .	7.85	4.94	.66	1.63	14.42
6222	Cahaba Acid Phos. & Potash Mixture...	B'ham Fertilizer Co., Birmingham, Ala....	8.80	5.85	.80	2.18	16.88
6437	Bone & Potash.....	R. W. Allen & Co., LaFayette, Ala.....	8.55	3.67	2.08	2.80	15.02



# Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATE

Station Number.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6206	High Grade Acid.....	Ozark Cotton S. O. M. and Fert. Co. Ozark, Ala.	11.95	8.12	.98	15.07
6220	B'ham High Grade Acid Phosphate....	Birmingham Fertilizer Co., Birmingham, Ala...	12.73	8.79	.20	16.52
6221	Birmingham Standard Grade Phosphate.	" " " "	11.83	8.62	.23	14.95
6227	H. G. Acid Phosphate (Light) .....	Ozark Cotton S. O. M. and Fert. Co., Ozark, Ala.	12.00	2.79	.44	14.79
6228	H. G. Acid Phosphate (Dark) .....	" " " "	12.80	4.24	1.76	16.54
6233	English Dis. Bone Phosphate.....	Troy Fertilizer Co., Troy, Ala.....	9.70	8.71	5.42	13.41
6234	Troy Acid Phosphate.....	" " " "	9.20	8.44	5.04	12.64
6235	H. G. Acid Phosphate.....	" " " "	9.40	8.26	4.94	12.66
6236	English Acid Phosphate.....	" " " "	9.45	2.58	5.24	12.01
6252	Acid Phosphate.....	P. R. Tunstall, Mobile, Ala.....	11.60	6.10	1.20	12.20

6253	Acid Phosphate.....	T. Y. Connor, Tuskegee.....	11.80	5.90	1.00	17.20
6262	B'ham H. G. Acid Phosphate.....	Birmingham Fertilizer Co., Birmingham, Ala.....	13.20	4.61	.84	17.81
6263	.. .. ..	.. .. ..	12.55	4.07	.48	16.62
6264	.. .. ..	.. .. ..	12.05	2.80	.10	14.85
6274	Acid.....	G. W. McKiny, Five Points, Ala.....	6.00	5.57	1.68	11.67
6276	Acid Phosphate.....	W. W. Mizell, Grimes, Ala.....	18.00	3.13	.22	16.13
6277	Phosphate.....	W. L. Patterson, Oswehee, Ala.....	5.25	3.77	1.78	10.02
6285	Acid Phosphate.....	W. J. Hulko, Abbeville, Ala.....	8.15	5.15	.90	13.80
6280	Oil Mill Phosphate.....	Dadeville Oil Mill, Dadeville, Ala.....	11.85	3.67	.48	15.02
6294	H. G. Acid Phosphate.....	Troy Fertilizer Co., Troy, Ala.....	10.15	3.58	.52	13.78
6296	Acid .....	S. M. Day, Five Points, Ala.....	11.20	4.98	.42	16.18
6307	H. G. Acid Phosphate.....	V. M. Harris, Kent, Ala.....	10.15	7.46	1.64	17.61
6316	Stono Dis. Bone .....	R. A. Russell & Co, Gaylesville, Ala.....	4.25	10.00	1.00	14.25
6319	Wando .....	.. .. ..	10.70	4.18	.72	14.88
6320	Acid Phosphate .....	D. H. Lewis, Gordon, Ala.....	1.00	8.95	2.20	9.95
6321	Diamond.....	O. & C. P. Dumas, Arlington, Ala.....	12.80	3.22	.08	15.52
6322	Georgia State Grange Acid Phosphate..	Wright, Henderson & Co., Elba, Ala.....	10.00	3.08	1.44	13.06
6323	Troy H. G. Acid.....	.. .. ..	11.20	1.96	4.74	13.16

## Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.

## ACID PHOSPHATES—Continued.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6328	Montgomery Phosphate.....	Jno. A. Nicholls, Childersburg, Ala.....	11.50	4.82	.86	15.82
6332	P. & H. Royal Acid Phosphate.....	Sanders & Son, Columbia, Ala.....	11.50	3.85	1.10	14.85
6335	Acid Phosphate.....	H. M. Beach & Son, Columbia, Ala.....	13.00	2.53	.62	15.53
6343	Ox H. G. Dis. Bone.....	T. C. Masterson, Aorca, Ala.....	11.50	4.26	1.94	15.76
6346	Scott's H. G. Acid.....	C. A. Steifelmeier, Hanceville, Ala.....	10.80	3.77	1.18	14.57
6358	Dis. Bone.....	Graves & Burdin, Deposit, Ala.....	8.20	2.82	7.38	11.02
6366	B'ham H. G. Phosphate.....	S. A. Stewart, Hartselle, Ala.....	11.50	2.79	.66	14.29
6372	Read's Matchless Acid.....	.....	9.25	5.10	2.00	14.35
6376	Oahaba H. G. Phosphate.....	S. F. Alston, Tuscaloosa, Ala.....	11.40	4.75	1.60	16.15
6381	Acid Phosphate.....	W. D. Hamilton, Guin, Ala.....	8.00	5.09	5.56	18.09

6384	Scott's H. G. Acid Phosphate.....	C. A. Steffelmeyer, Cullman, Ala.....	14.00	2.84	.38	16.84
6386	B'ham Acid Phosphate .....	" " " .....	9.90	3.74	.76	13.64
6388	Atlas Acid Phosphate.....	" " " .....	14.40	2.98	1.22	17.88
6392	Ga. State Standard Acid Phosphate.....	Law & Davis, Lincoln, Ala.....	8.55	9.79	2.26	13.54
6398	Scott's H. G. Phosphate.....	" " " .....	9.10	6.24	2.16	15.84
6397	Teague's Acid Phosphate.....	S. F. Teague, Birmingham, Ala.....	9.80	6.14	3.16	15.44
6401	Scott's H. G. Acid.....	T. H. & A. B. Stephens, Seaborn, Ala.....	10.35	5.94	1.66	16.29
6404	B'ham H. G. Acid Phosphate.....	F. Ogden & Son, Sulligent, Ala.....	10.15	4.15	.70	14.80
6407	Ox H. G. Dis. Bone .....	Porter & Foster, Town Creek, Ala.....	13.65	3.82	1.48	17.47
6408	Ala. Acid Phosphate.....	J. B. Gray & W. W. Gullledge, Ohatchie, Ala.....	7.95	4.85	5.00	12.80
6426	H. G. Acid Phosphate .....	J. R. G. Howell, Dothan, Ala.....	5.05	3.89	1.76	13.94
6430	Dis. Bone Acid.....	Weathers, Swann & Co., Roanoke, Ala.....	8.10	5.29	.56	13.89
6438	Tuscaloosa Acid Phosphate.....	Tuscaloosa C. S. Oil Co., Tuscaloosa, Ala.....	13.95	3.98	.62	17.88
6436	H. G. Acid Phosphate.....	Hughes Bros., Florale, Ala.....	12.75	5.56	1.44	18.81
6440	Troy Acid Phosphate.....	Troy Fertilizer Co., Troy, Ala.....	9.85	4.50	2.50	14.85
6441	H. G. Acid Phosphate.....	" " " .....	9.25	4.48	1.72	13.78
6442	English Acid Phosphate.....	" " " .....	9.90	3.71	3.60	13.61
6443	English Dis. Bone Phosphate.....	" " " .....	9.60	3.98	2.72	13.58

Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.  
ACID PHOSPHATES—Continued.

Station No.	NAME OF SAMPLE.	By WHOM SENT.	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6450	Excelsior Acid Phosphate	P. J. Ham & Son, Elba, Ala.	13.40	3.47	.38	16.87
6451	Pomona	" " " "	1.76	3.47	.18	16.22
6457	Ga. State Grange Acid Phosphate	Hilton, Bently & Cosby, Brantley, Ala.	10.10	4.05	1.30	14.15
6465	H. G. Acid Phosphate	J. T. Ramage, Brundidge, Ala.	13.55	3.16	2.54	16.71
6466	" " " "	" " " "	11.95	6.08	1.98	18.08
6467	" " " "	" " " "	9.54	7.17	1.88	16.62
6471	Goulding's H G. Acid Phosphate	W. F. McKenzie, Greenville, Ala.	14.85	3.42	.88	18.27
6474	J. C. Akin & Son's No. Acid Phosphate	J. C. Akin & Son, Notasulga, Ala.	10.35	4.41	4.04	14.76
6477	H G. Acid Phosphate	First Bank of Elba, Elba, Ala.	12.50	2.67	3.58	15.17
6486	" " " "	W. E. Townsend, Elrath, Ala.	.95	9.82	1.48	10.77

6494	H. G. Acid Phosphate . . . . .	Burks & Coston, Brantley, Ala . . . . .	8.55	4.51	4.84	13.06
6496	H. G. Dis. Bone . . . . .	M. F. Patterson, Falkville, Ala . . . . .	12.50	3.50	3.60	16.00
6501	Acid Phosphate . . . . .	McMillan & Harrison, Mobile, Ala . . . . .	14.20	3.65	0.20	17.85
6504	H. G. Acid Phosphate . . . . .	W. S. Crass, Pelham, Ala . . . . .	11.53	3.21	1.56	14.76
6506	.. .. .	Troy Fertilizer Co., Troy, Ala . . . . .	15.30	1.76	1.94	17.08
6507	.. .. .	G. A. Sanders, Luverne, Ala . . . . .	15.25	2.34	3.26	17.59
6511	.. English Acid Phosphate . . . . .	A. J. Pittman, Wehodkae, Ala . . . . .	10.45	5.29	4.78	15.74
6515	H. G. Dis. Bone . . . . .	W. A. Gage & Co., Town Creek, Ala . . . . .	12.25	4.42	2.08	16.67
6519	Dis. Bone . . . . .	Phillips Bros., Oxford, Ala . . . . .	6.95	8.80	1.00	15.25
6523	Scott's H. G. Acid Phosphate . . . . .	Ingram & Co., Anniston, Ala . . . . .	12.10	4.61	1.04	16.17
6526	Eddystone Dis. Bone . . . . .	J. Markentepe, Cullman, Ala . . . . .	10.75	5.89	3.86	16.64
6529	H. G. Acid Phosphate . . . . .	S. N. Power, Elba, Ala . . . . .	13.00	4.07	1.58	17.07
6530	S. & Co's H. G. English Acid Phosphate . . . . .	Schuessler & Co., Roanoke, Ala . . . . .	9.45	4.91	5.74	14.86
6537	Pure H. G. Acid Phosphate . . . . .	Britt & Johnson, Wetumpka, Ala . . . . .	11.80	3.62	.58	15.42
6539	H. G. Acid Phosphate . . . . .	McEntyre, Henderson & Adams, Osark, Ala . . . . .	13.00	3.81	3.84	16.81
6546	.. .. .	B. Bullard, Elba, Ala . . . . .	9.35	7.27	.48	16.62
6549	Imperial Dis. Bone . . . . .	George Kroell, Montevallo, Ala . . . . .	11.35	3.88	.82	15.23
6551	H. G. Acid Phosphate . . . . .	H. R. & H., Brantley, Ala . . . . .	13.35	5.23	3.32	18.58

Analyses Reported by State Chemist from July 1st, 1900 to July 1st, 1901.  
ACID PHOSPHATES—Continued.

Station No.	NAME OF SAMPLE.	By Whom SENT.	PHOSPHORIC ACID.				Commercial value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
6558	B'ham H. G. Acid Phosphate.....	Geo. M. Truss & Co., Springville, Ala.....	13.95	5.10	20	\$19.05	
6562	Acid Phosphate.....	J. O. Hodges, Ashville, Ala.....	9.70	6.00	2.50	15.70	
6564	Bear Dis. Bone.....	A. P. Howison, Randolph, Ala.....	13.00	5.76	2.84	18.76	
6569	H. G. English Acid.....	M. W. Carlyle & Bro., Roanoke, Ala.....	6.90	6.15	6.80	13.05	
6576	Matchless Acid Phosphate.....	Sessions & Mizell, Enterprise, Ala.....	7.90	4.19	3.76	12.09	
6580	Birmingham Acid.....	T. A. Howle & Co., Oxford, Ala.....	6.75	7.08	.92	13.83	
6585	Acid Phosphate.....	F. T. & J. C. Butler, Paint Rock, Ala.....	7.95	5.16	5.84	*3.11	
6589	Imperial Acid.....	T. G. Land, Cullman, Ala.....	12.20	3.00	1.30	15.20	
6589	Stern's H. G. Acid Phosphate.....	Chapman & Co., Geneva, Ala.....	12.70	6.10	1.70	18.80	
6592	No. 1 Wet Phosphate.....	J. S. Collins, Geneva, Ala.....	3.50	6.99	4.56	10.49	

6598 No. 2 Wet Phosphate.....	J. S. Collins, Geneva, Ala.....	12.15	6.80	.90	18.96
6595 Crescent City Acid Phosphate.....	Crutcher & Ward, Ouba, Ala.....	12.60	4.09	2.76	16.60
6596 I. X. L. Acid Phosphate.....	.. .. .	12.80	5.51	2.04	18.31
6298 Read Phosphate.....	M. P. White, Attalla, Ala.....	9.00	5.68	.92	14.68
6600 Scott's H. G. Acid Phosphate.....	W. J. Silbert, Gadsden, Ala.....	12.36	3.82	.98	16.17
6602 I. X. L. Phosphate.....	Chas. Ivey, Evergreen, Ala.....	10.40	4.46	5.24	14.86
6604 H. G. Acid Phosphate.....	Zena Sheperd, Georgians, Ala.....	11.10	5.22	2.28	16.32
6606 .. .. .	J. I. Covington, Bertha, Ala.....	8.70	5.82	.98	14.52
6612 Acid Phosphate.....	J. W. Grace, Elkmont, Ala.....	8.50	4.51	5.86	18.04
6614 Tenn. Valley Acid Phosphate.....	J. O. Hartselle & Son, Hartselle, Ala.....	6.65	4.26	6.44	10.91
6615 Florence Acid .. .. .	.. .. .	8.86	5.45	6.40	18.80
6618 .. .. Phosphate.....	W. A. Shaw, Winfield, Ala.....	8.45	4.98	4.02	18.38
6620 Tuscaloosa Acid Phosphate.....	O. R. Maxwell, Northport, Ala.....	13.65	4.58	1.62	18.23
6623 Bear H. G. Dis. Bone.....	Bean & Murray, Heflin, Ala.....	6.96	8.13	1.42	15.18
6627 Sunny South Acid Phosphate.....	Elrod & Gibson, Collinsville, Ala.....	10.10	5.42	3.08	15.52
6629 Ox Acid Phosphate.....	Eranzen & Olson, Thorsby, Ala.....	9.60	6.49	2.86	16.00
6630 Ox H. G. Dis Bone.....	.. .. .	9.45	5.33	2.12	14.78
6632 Cahaba Acid Phosphate.....	T. U. Crumpton, Maplesville, Ala.....	9.80	3.01	.54	13.71



### Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATES.

Station Number.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.				Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.		
6838	Acid.....	Asa Griffith, Hanceville, Ala.....	12.20	4.90	3.20	16.50	
6838	Birmingham Acid.....	.. .. .	10.80	3.80	1.05	13.60	
6844	XXX Dis. Bone....	G. W. Wise, Madison, Ala.....	7.85	5.65	3.25	13.00	
6845	Sunny South.....	.. .. .	9.25	5.35	3.55	14.60	
6846	Meridian Southern Acid.....	G. H. Amos, Duck Spring, Ala.....	11.65	4.15	2.80	15.80	
6852	Georgia State Grange Acid.....	F. D. Bynum, Bynum, Ala.....	8.75	9.70	1.45	18.45	
6855	A. G. Winkler's H. G. Acid Phosphate..	A. G. Winkler, Greenville, Ala.....	17.20	1.75	.25	18.95	
6857	Talladega Acid Phosphate.....	John H. Wilson, Jenifer, Ala.....	19.30	3.20	.70	16.50	
6860	Ox H. G. Dis. Bone.....	Hertzell & Anderson, Madison, Ala.....	11.10	7.90	.40	19.00	
6861	Cahaba Acid Phosphate.....	John H. Wilson, Jenifer, Ala.....	13.20	8.85	.40	17.00	

6668	English Acid Phosphate.....	W. W. Burnett, Geneva, Ala.....	12.00	4.45	2.00	16.45
6669	Port Royal Dis Bone.....	Lull & Lacey, Wetumpka, Ala.....	12.85	2.15	.70	14.50
6670	Acid Phosphate.....	Stewart & Hazelwood, Eden, Ala.....	5.40	5.77	.48	11.17
6671	Dis Bone.....	.....	8.95	3.84	.88	11.79
6673	Georgia State Standard.....	D. D. Hughes, Lebanon, Ala.....	2.80	10.73	2.02	13.08
6675	Prolific Acid Phosphate.....	D. D. McGowan, Cuba, Ala.....	14.50	4.40	.80	18.90
6476	Acid Phosphate.....	Cash Supply Co., Mountaln Creek, Ala.....	11.60	2.07	1.08	13.67
6681	No. 1. Dis. Bone.....	Trawick & Jernigan, Opelika, Ala.....	9.50	4.86	3.84	14.36
6682	No. 2 Dis. Bone.....	.....	10.00	4.25	3.40	14.75
6690	I. X. L. Phosphate.....	W. D. Brown, Graville, Ala.....	11.85	4.05	2.50	15.90
6691	Goulding's H. G. Phosphate.....	.....	12.50	3.60	1.45	16.10
6692	Alabama Pure H. G. Phosphate.....	.....	11.10	4.65	1.95	15.75
6701	Alabama Phosphate.....	Green & Mullins, Active, Ala.....	19.55	5.20	2.55	15.75
6704	Tallapoosa Dis. Bone.....	White & Spigner, Goodwater, Ala.....	10.40	1.15	4.55	11.55
6711	Phosphate Excelsior Bone Compound.....	W. C. Perry, Seale, Ala.....	6.60	6.40	.70	18.00
6716	Eddystone Dis. Bone.....	W. H. Bynum, Boaz, Ala.....	8.25	7.85	2.25	16.10
6718	Alabama Acid Phosphate.....	J. H. Myers, Langston, Ala.....	14.05	2.80	.40	16.85
6721	No. 1 Acid Phosphate.....	J. C. Alford, Childersburg, Ala.....	9.55	8.20	1.05	17.75

**Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.**  
**ACID PHOSPHATES—Concluded.**

Station No.	NAME OF SAMPLE.	By WHOM SENT.	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6722	No. 2 Acid Phosphate.....	J. C. Alford, Childersburg, Ala.....	12.15	6.15	.96	\$18.30
6729	Magnet Acid.....	Davis, Marshall & Co., Mobile, Ala.....	9.55	6.92	2.98	16.47
6782	Piedmont Acid Phosphate.....	R. F. Gilbert, Porterville, Ala.....	7.85	5.71	.54	13.66
6788	H. G. Acid Phosphate.....	Gunter & Elem, Gantt, Ala.....	13.45	3.65	2.80	17.10
6742	Cow Acid.....	McEntire Bros., Cullman, Ala.....	5.90	8.08	4.62	13.98
6743	Bull Acid.....	.. .. .	7.10	4.87	7.88	11.97
6746	Acid Phosphate.....	S. W. Henry, Springville, Ala.....	8.15	5.42	8.98	19.57
6749	XXX Dia. Bone.....	R. Q. Edmoulson & Bros., Eufaula, Ala.....	6.85	7.12	2.28	18.97
6755	Acid Phosphate.....	T. L. Johnson & Co., Gadsden, Ala.....	9.65	5.48	1.82	15.18
6756	J. C. Adkin & Son's No. 1 Acid Phosphate	Opelika Chemical Co., Opelika, Ala.....	10.80	5.61	2.54	16.41

6757	Griel Bros. English Acid Phosphate .....	Opelka Chemical Co., Opelka, Ala.....	10.70	6.59	1.86	17.29
6758	Standard Acid Phosphate .....	.. .. .	11.30	6.04	2.00	17.80
6759	H. G. English Acid Phosphate .....	.. .. .	10.90	6.48	2.02	17.88
6760	S. & Co's H. G. English Acid .....	.. .. .	10.75	6.89	2.46	17.14
6761	H. & T. H. G. Acid Phosphate .....	.. .. .	10.65	6.63	2.52	17.28
6780	H. G. Acid Phosphate .....	Montgomery Fertilizer Co., Montgomery, Ala...	11.05	5.69	2.26	16.74
6781	Vandiver's XX Acid Phosphate .....	.. .. .	10.25	6.18	2.82	16.88
6782	S. & O. H. G. Acid Phosphate .....	.. .. .	11.05	5.95	2.80	17.00
6783	Thompson's English Acid Phosphate .....	.. .. .	10.95	6.26	1.84	17.21
6784	Star Brand Acid Phosphate .....	.. .. .	10.85	5.76	2.54	16.61
6785	Early Bird H. G. Acid Phosphate .....	.. .. .	10.40	7.25	1.80	17.65
6786	S. & K. English Acid Phosphate .....	.. .. .	11.05	6.81	1.84	17.66
6787	W. L. & Co's H. G. Acid Phosphate .....	.. .. .	11.20	6.18	2.12	17.88
6803	H. G. English Acid Phosphate .....	.. .. .	11.65	4.78	2.42	16.83
6808	H. G. Acid Phosphate .....	W. B. Willhite, Hartselle, Ala.....	8.80	6.28	2.52	15.06
6811	Dixie Acid Phosphate .....	C. W. Bell & Son, Lineville, Ala.....	10.90	4.87	4.53	15.77
6812	H. G. Dis. Bone .....	.. .. .	5.70	7.45	5.80	13.15
6815	H. G. Acid Phosphate .....	G. W. Roberts & Co., Collinsville, Ala.....	4.80	7.49	1.86	12.29

# Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATE.

Station Number.	NAME OF SAMPLE.	By Whom Sent	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6821	Marietta H. G. Acid .....	Reeves, Sanders & Co, Heflin, Ala .....	11.70	5.14	.28	16.84
6824	Sunny South Acid Phosphate .....	W. B. Vaughn, Elkmomit, Ala .....	9.00	6.09	6.58	15.09
6827	H. G. Acid Phosphate .....	F. A. Gullledge, Verbena, Ala .....	13.95	5.13	0.42	19.08
6828	Ox Dis. Bone .....	.. .. ..	10.75	5.17	2.68	15.92
6830	Coweta H. G. Acid .....	White & Aubrey, Roanoke, Ala .....	6.90	4.69	3.26	11.59
6838	Sunny South Phosphate .....	A. B. Vandigraft & Son, Birmingham, Ala .....	10.50	5.12	2.98	15.62
6842	English Acid Phosphate .....	E. H. & A. S. Murdock, Coffee Springs, Ala .....	10.70	6.32	1.88	17.02
6844	Standard Acid Phosphate .....	Cameron Bros., Notasulga, Ala .....	9.26	5.79	3.46	15.04
6846	Bear H. G. Dis. Bone .....	T. L. Neighbors & Bros, Goodwater, Ala .....	10.50	4.78	3.02	15.28
6852	Birmingham H. G. Acid Phosphate .....	W. J. Mullins, Clanton, Ala .....	11.40	4.35	.75	15.75

6856	Marietta H. G. Dia. Bone Acid.....	West & McMurry, Roanoke, Ala.....	6.65	4.77	.78	11.42
6858	Eddystone Dia. Bone.....	Montgomery Bros., Lincoln, Ala.....	10.45	4.79	2.86	15.24
6861	Adair's H. G. Dia. Bone.....	John T. Tabor, Keener, Ala.....	10.25	2.10	3.80	12.85
6864	Scott's Acid.....	Haley Bros., Haleyville, Ala.....	12.35	4.04	1.06	16.89
6865	Florence Acid.....	.. .. .	8.85	5.60	4.80	14.45
6866	Bear Acid.....	.. .. .	10.15	5.74	3.16	15.89
6871	Howle Bros. Acid Phosphate.....	Howle Bros., Wetumpka, Ala.....	11.35	6.48	.52	17.88
6873	Phosphate No. 3.....	Ozark C. S. Oil Mill and Fert. Co., Ozark, Ala..	8.20	7.15	1.40	15.35
6875	Black Diamond Acid.....	E. P. Duncan, Alexander City, Ala.....	7.39	7.06	2.54	14.86
6881	Tiger Acid.....	The J. H. Karter Co., Cullman, Ala.....	7.90	6.10	6.20	14.00
6884	English Acid Phosphate.....	T. H. McEntyre, Coffee Springs, Ala.....	9.00	5.77	3.08	14.77
6886	Eagle Acid Phosphate.....	L. O. Cox, Boaz, Ala.....	5.45	8.01	3.84	13.48
6887	Eagle Dis. Bones.....	.. .. .	6.00	8.14	2.16	14.14
6895	Sunny South Acid.....	M. Noble, Avery, Ala.....	9.35	4.54	3.46	13.89
6897	Phosphate.....	Rintz Turner, Thomasville, Ala.....	9.65	4.08	1.22	13.68
6899	Acid Phosphate.....	T. B. Williams, Cullman, Ala.....	9.70	5.62	3.48	15.82
6904	Eagle Acid Phosphate.....	S. J. Baird, Guin, Ala.....	10.55	5.94	5.06	16.49
6905	Tallapoosa H. G. Acid Phosphate.....	Tallapoosa Oil Co, Alexander City, Ala.....	9.90	5.35	.70	15.25

# Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.

## ACID PHOSPHATE.

Station Number.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.	
6220	Cahaba H. G. Acid Phosphate .....	Birmingham Fertilizer Co., Birmingham, Ala.	12.78	8.79	.20	16.52
6220	Earle Terrell & Co's. H. G. Acid Phos.	.. ..	12.78	8.79	.20	16.52
6221	Cahaba Standard Grade Phosphate .....	.. ..	11.33	8.62	.23	14.95
6220	Prolific Acid* Phosphate .. .....	.. ..	12.78	8.79	.20	16.52

**Analyses Reported by the State Chemist from July 1, 1900, to July 1, 1901.**  
**MISCELLANEOUS FERTILIZERS AND FERTILIZING MATERIALS.**

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.
			Citrate Soluble.	Acid Soluble.	Total.		
6214	Cotton Seed Meal.....	Tucker & Willingham, LaFayette, Ala.....	.....	.....	2.79	7.14	2.06
6215	.. .. Off.....	.. .. ..	.....	.....	2.77	6.18	1.62
6216	.. .. ..	Mutual Cotton Oil Co., Columbus, Ga.....	.....	.....	.....	7.20	.....
6217	.. .. ..	Dothan .. .. Dothan, Ala.....	.....	.....	2.80	7.32	1.89
6218	.. .. Off.....	.. .. ..	.....	.....	2.88	6.42	1.87
6219	.. .. ..	LaFayette Cotton Oil Co., LaFayette, Ala.....	.....	.....	2.86	6.42	2.01
6255	.. .. No. 1.....	Dadeville Oil Mill, Dadeville, Ala.....	.....	.....	2.87	7.11	1.95
6256	.. .. No. 2 Off.....	.. .. ..	.....	.....	2.61	6.86	1.99
6260	.. .. ..	Walter Andrews, LaFayette, ..	.....	.....	2.65	6.84	2.04
6261	.. .. Off.....	.. .. ..	.....	.....	2.90	6.94	1.94





6364	Cotton Seed Meal	O. C. Woodard, Fruitdale, Ala.	.....	.....	8.75	7.08	1.78
6365	"	Evergreen Mfg Co., Evergreen, Ala.	.....	.....	2.80	6.84	1.64
6414	"	Jackson & Chapman, Grand Bay,	.....	.....	3.56	6.84	2.15
6458	" Off	O. C. Woodard, Fruitdale,	.....	.....	8.82	7.02	2.82
6459	" Bright	" "	.....	.....	3.25	6.98	1.91
6662	"	Leder Oil Mills, Demopolis,	.....	.....	3.18	6.84	1.84
7048	"	" "	.....	.....	3.80	6.98	1.60
6202	Bat Manure & Cave Earth	L. H. Scruggs, Huntsville,	.....	.....	9.85	2.84	1.51
6208	Coarse Horse Manure	J. F. Duggar, Auburn,	.....	.....	.52	1.27	1.80
6208	Fine Horse Manure	" "	.....	.....	.67	.87	1.00
6206	Fertilizer No. 7	Helm Milling Co., Birmingham,	.....	.....	.....	.....	2.62
6207	Muriate of Potash	Ozark C. S. Oil Mill & Fert. Co., Ozark,	.....	.....	.....	.....	56.15
6213	Tankage	B'ham Hide & Tallow Co., B'ham, Ala.	.....	.....	10.18	6.04	.....
6226	Fertilizer No. 1748	Mississippi Station, Starkville, Ala.	.....	.....	.....	.....	2.75
6251	German Kainit	Troy Fertilizer Co., Troy, Ala.	.....	.....	.....	.....	13.40
6258	Kainit	Trawick & Jernigan, Opelika, Ala.	.....	.....	.....	.....	14.12
6281	Ashes	O. C. Woodard, Fruitdale,	.....	.....	1.85	.....	1.28
6288	Soil	F. Y. Anderson, Birmingham,	.....	.....	.20	.07	.06

**Analyses Reported by the State Chemist from July 1, 1900 to July 1, 1901.**  
**MISCELLANEOUS FERTILIZERS AND FERTILIZING MATERIALS—Concluded.**

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.
			Citrate Soluble.	Acid Soluble.	Total.		
6289	Soil.....	Prattville Mercantile Co., Prattville, Ala.	.....	.....	.26	.08	.06
6300	Muriate.....	C. C. Woodard, Fruitdale, Ala.	.....	.....	.....	.....	51.90
6439	Phosphate Rock.....	J. C. Adams, Montgomery, Ala.	.....	.....	.45	.....	.....
6464	Cotton Seed Meal Ash.....	Huntsville Nursery Co., Huntsville, Ala.	15.68	.60	16.28	.....	1.20
6500	German Kainit.....	McMillan & Harrison, Mobile, Ala.	.....	.....	.....	.....	12.64
6566	No. 1 Phos. Rock.....	J. A. Alexander, Prattville, Ala.	.....	.....	1.45	.....	.....
6567	No. 2 .. ..	.....	.....	.....	.40	.....	.....
6568	No. 3 .. ..	.....	.....	.....	.45	.....	.....
6596	Kainit.....	F. T. & J. C. Butler, Paint Rock, Ala.	.....	.....	.....	.....	10.74
6696	Marl.....	J. F. Jones, Evergreen, Ala.	.....	.....	.28	.....	.....

6889	Kalnitz .....	J. H. Wilson, Jenifer, Ala.....	.....	.....	.....	18.14
6781	German Kalnit.....	Davis, Marshall & Co., Mobile, Ala.....	.....	.....	.....	14.14
6849	Phosphate Rock.....	H. S. Houghton, Blount Springs, Ala.....	.....	.....	.....	.....
6850	.. ..	Prim & Kimbel, Jackson, Ala.....	.....	.....	.82	.....
7049	.. ..	C. F. Austin, Auburn, Ala.....	.....	.....	.22	.....
7050	.. ..	A. U. Grouby, Abbeville, Ala.....	.....	.....	.72	.....
6211	Pure Tobacco Stems.....	Helm Milling Co., Birmingham, Ala.....	.....	.....	.84	.....
6212	Mixture Tobacco Stems and Filler.....	.. ..	.. ..	.. ..	.....	9.18
						2.48

# Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

## MISCELLANEOUS SAMPLES FROM THE COMMISSIONER.

Station No.	NAME OF SAMPLE.)	By Whom Sent.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6914	No. 806. ....	Commissioner of Agriculture, Montgomery, Ala.	12.70	3.79	.76	.....	2.40	\$18.89
6915	" 807. ....	" " " " " "	7.40	3.22	3.78	.....	2.59	18.21
6916	" 808. ....	" " " " " "	11.95	5.59	.66	.....	.....	17.54
6917	" 809. ....	" " " " " "	7.95	5.78	4.82	1.28	2.29	18.60
6918	" 810. ....	" " " " " "	11.95	3.10	1.06	.....	2.69	17.83
6919	" 811. ....	" " " " " "	6.35	3.15	2.50	1.80	2.59	16.57
6920	" 812. ....	" " " " " "	11.85	5.07	.88	.....	2.58	19.50
6921	" 813. ....	" " " " " "	11.55	5.10	.80	.....	2.40	19.06
6922	" 814. ....	" " " " " "	7.35	2.66	3.54	1.80	2.10	16.55
6923	" 815. ....	" " " " " "	11.20	6.20	.80	.....	2.05	19.45

6924	No. 816	..	..	..	..	7.30	3.78	.12	1.94	2.20	18.71
6925	.. 817	..	..	..	..	6.60	3.67	4.08	1.82	2.29	17.66
6926	.. 818	..	..	..	..	6.40	4.20	7.70	1.98	2.18	18.27
6927	.. 819	..	..	..	..	18.06	3.89	.96	.....	.....	18.44
6928	.. 820	..	..	..	..	6.50	4.54	2.46	1.00	2.45	16.29
6929	.. 821	..	..	..	..	7.70	6.21	5.84	.....	.....	18.91
6930	.. 822	..	..	..	..	7.60	3.53	2.62	1.82	1.80	18.08
6931	.. 823	..	..	..	..	7.70	5.80	1.90	1.64	1.80	18.49
6932	.. 824	..	..	..	..	9.85	3.55	6.20	.....	1.41	14.31
6933	.. 825	..	..	..	..	6.95	3.04	5.98	2.14	1.67	17.06
6934	.. 826	..	..	..	..	7.75	2.94	1.28	.....	2.40	18.09
6935	.. 827	..	..	..	..	10.75	2.59	3.36	1.42	2.49	19.81
6936	.. 828	..	..	..	..	8.70	2.56	.94	1.96	2.31	19.08
6937	.. 829	..	..	..	..	8.70	2.28	1.52	1.80	2.67	17.24
6938	.. 830	..	..	..	..	8.85	5.44	.96	.....	.....	18.79
6939	.. 831	..	..	..	..	10.25	4.06	.72	.28	2.38	19.49
6940	.. 832	..	..	..	..	7.00	3.84	3.28	1.72	2.40	17.56
6941	.. 833	..	..	..	..	8.40	4.28	1.42	1.72	2.05	19.50

# Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.

## MISCELLANEOUS SAMPLES FROM THE COMMISSIONER—Continued.

Station No.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
6842	No. 834 .....	Commissioner of Agriculture, Montgomery, Ala	8.70	6.68	2.12		.18	2.57	\$18.45
6843	.. 835 .....		9.55	3.19	1.66		1.88	2.56	20.56
6844	.. 836 .....		6.95	5.32	8.53		.50	1.82	14.99
6845	.. 837 .....		7.95	6.81	7.84		.....	.....	14.76
6846	.. 838 .....		7.86	5.50	2.10		1.72	1.48	19.70
6847	.. 839 .....		11.80	6.05	2.20		.....	.....	17.85
6848	.. 840 .....		8.40	4.58	8.82		.98	1.66	17.88
6849	.. 841 .....		4.55	4.40	1.00		.....	.....	18.95
6850	.. 842 .....		8.60	3.48	2.12		1.88	2.10	19.44
6851	.. 843 .....		.....	.....	.....		.....	18.60	18.60

6952	..	844	..	..	..	9.15	8.61	2.84	1.06	2.24	17.97
6953	..	845	..	..	..	12.60	8.50	2.40	.....	.....	16.10
6954	..	846	..	..	..	6.85	4.15	8.50	1.96	1.54	18.08
6955	..	847	..	..	..	11.70	2.98	1.72	.....	.....	14.68
6956	..	848	..	..	..	9.00	1.81	1.84	1.76	1.89	17.18
6957	..	849	..	..	..	7.85	8.48	.82	.12	2.22	18.84
6958	..	850	..	..	..	7.20	4.49	4.06	1.88	2.41	19.86
6959	..	851	..	..	..	7.45	8.80	6.65	1.86	1.80	16.86
6960	..	852	..	..	..	6.70	2.98	6.82	1.88	1.49	16.43
6961	..	853	..	..	..	11.65	5.56	1.84	.....	.....	17.21
6962	..	854	..	..	..	6.25	4.57	2.26	1.92	2.59	18.79
6963	..	855	..	..	..	7.20	8.92	.78	2.88	2.44	20.22
6964	..	856	..	..	..	5.45	6.62	2.28	.....	.....	12.07
6965	..	857	..	..	..	10.40	4.44	8.66	.....	.....	14.84
6966	..	858	..	..	..	7.50	4.40	5.40	2.18	1.48	19.43
6967	..	859	..	..	..	6.65	8.12	2.68	1.70	2.89	16.92
6968	..	860	..	..	..	5.06	10.42	1.68	.....	.....	15.47
6969	..	861	..	..	..	5.50	4.89	6.66	1.86	2.68	18.28

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**Analyses Reported by State Chemist from July 1, 1900, to July 1, 1901.**  
**MISCELLANEOUS SAMPLES FROM THE COMMISSIONER.**

Station Number.	NAME OF SAMPLE.	BY WHOM SENT.	PHOSPHORIC ACID.			Nitrogen.	Potash.	Commercial Value.
			Water Soluble.	Citrate Soluble.	Acid Soluble.			
6970	No. 862.....	Commissioner of Agriculture, Montgomery, Ala.	9.80	7.37	4.38	....	....	17.17
6971	" 863.....	" "	11.20	5.06	.84	....	....	16.20
6972	" 864.....	" "	8.65	4.65	2.80	2.04	8.88	20.84
6973	" 865.....	" "	....	....	....	....	12.28	12.28
6974	" 866.....	" "	12.40	6.54	2.26	....	....	18.94
6975	" 867.....	" "	4.90	6.06	6.94	1.86	2.31	18.48
6976	" 868.....	" "	12.65	3.98	.92	....	.52	17.10
6977	" 869.....	" "	13.16	3.87	1.06	....	....	17.02
6978	" 870.....	" "	13.00	5.20	1.00	....	....	18.20
6979	" 871.....	" "	8.10	4.85	3.20	.82	2.24	17.58

688	No. 872	..	..	..	..	1.65	12.79	2.08	.....	.....	14.44
6881	.. 873	..	..	..	..	7.45	8.02	1.88	.....	.....	15.47
6882	.. 874	..	..	..	..	6.80	8.25	2.40	1.72	2.75	17.62
6883	.. 875	..	..	..	..	7.25	8.96	2.94	2.80	2.14	19.79
6884	.. 876	..	..	..	..	6.10	8.49	2.66	1.84	1.91	16.65
6885	.. 877	..	..	..	..	5.44	12.84	.62	.....	.....	17.78
6886	.. 878	..	..	..	..	7.75	8.47	5.88	1.72	1.64	17.7
6887	.. 879	..	..	..	..	8.45	5.11	4.84	1.04	1.81	17.7
6888	.. 880	..	..	..	..	9.10	5.59	3.56	.68	1.67	18.26
6889	.. 881	..	..	..	..	5.12	10.19	.54	.02	1.42	16.79
6890	.. 882	..	..	..	..	10.85	8.28	.52	.04	1.19	15.48
6891	.. 883	..	..	..	..	5.25	3.71	.44	1.20	3.00	15.82
6892	.. 884	..	..	..	..	6.90	2.90	.95	.....	2.18	11.98
6893	.. 885	..	..	..	..	10.90	4.69	1.54	.....	.....	15.59
6894	.. 886	..	..	..	..	7.05	6.35	2.10	.16	2.41	16.28
6895	.. 887	..	..	..	..	8.85	2.95	2.20	.....	.....	12.80
6896	.. 888	..	..	..	..	8.05	2.09	1.86	.....	.....	10.14
6897	.. 889	..	..	..	..	9.70	.35	6.70	2.02	1.69	17.40

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**Analyses Reported by State Chemist from July 1st, 1900, to July 1st, 1901.**  
**MISCELLANEOUS SAMPLES FROM THE COMMISSIONER—Continued.**

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
6898	No. 890 .....	Commissioner of Agriculture, Montgomery, Ala	7.10	5.00	4.00	1.78	1.94	\$18.42	
6899	.. 891 .....		5.80	4.88	1.22	2.82	2.27	19.45	
7000	.. 892 .....		6.00	6.54	1.96	1.24	1.54	17.55	
7001	.. 893 .....		7.35	8.04	3.26	1.66	2.29	17.8	
7002	.. 894 .....		4.55	9.37	.98	8.54	2.41	25.24	
7003	.. 895 .....		2.65	8.14	.86	1.92	2.56	18.78	
7004	.. 896 .....		2.25	9.88	.62	2.04	1.91	19.20	
7005	.. 897 .....		2.40	9.66	1.84	2.40	2.64	21.32	
7006	.. 898 .....		8.55	3.65	3.26	1.24	2.28	17.99	
7007	.. 899 .....	..	9.95	1.85	9.90	.....	.....	11.80	

7008	.. 900	..	..	..	..	8.95	2.85	2.80	1.28	1.04	16.28
7009	.. 901	..	..	..	..	8.20	8.89	1.96	..	2.24	18.88
7010	.. 902	..	..	..	..	11.60	5.11	1.54	.12	.18	17.18
7011	.. 903	..	..	..	..	11.25	6.01	8.04	08	.10	17.58
7012	.. 904	..	..	..	..	5.00	4.97	1.98	..	2.77	12.74
7013	.. 905	..	..	..	..	7.90	4.87	6.48	.10	2.91	15.86
7014	.. 906	..	..	..	..	6.80	3.51	1.04	2.08	1.51	17.61
7015	.. 907	..	..	..	..	7.70	3.52	.88	1.96	2.51	19.2
7016	.. 908	..	..	..	..	5.10	3.81	2.04	1.98	2.72	17.17
7017	.. 909	..	..	..	..	12.70	3.28	4.82	..	..	15.98
7018	.. 910	..	..	..	..	7.40	2.06	3.64	2.04	2.06	17.26
7019	.. 911	..	..	..	..	7.75	5.49	1.86	1.02	1.26	17.18
7020	.. 912	..	..	..	..	8.80	7.43	2.92	..	2.00	17.73
7021	.. 913	..	..	..	..	6.85	5.67	4.28	..	..	12.52
7022	.. 914	..	..	..	..	8.00	2.12	3.96	1.88	2.18	16.16
7023	.. 915	..	..	..	..	7.95	4.21	2.64	1.84	1.22	17.18
7024	.. 916	..	..	..	..	9.25	5.63	2.92	..	..	14.86
7025	.. 917	..	..	..	..	9.00	3.44	1.96	1.56	1.57	18.88

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**Analyses Reported by State Chemist from July 1, 1900 to July 1, 1901.**  
**MISCELLANEOUS SAMPLES FROM THE COMMISSIONER—Concluded.**

Station No.	NAME OF SAMPLE.	By Whom Sent.	PHOSPHORIC ACID.				Nitrogen.	Potash.	Commercial Value
			Water Soluble.	Citrate Soluble.	Acid Soluble.				
7026	No. 918 .....	Commissioner of Agriculture, Montgomery, Ala.	9.15	.50	1.90		1.48	2.73	16.52
7027	.. 919 .....	..	7.60	3.11	2.74		2.02	2.00	18.37
7028	.. 920 .....	..	8.08	3.74	.66			3.22	15.56
7029	.. 921 .....	..	9.20	1.54	1.36		1.70	2.77	18.27
7030	.. 922 .....	..	9.25	4.02	1.58		1.62	1.86	19.17
7031	.. 923 .....	..	10.35	5.64	5.86				15.99
7032	.. 924 .....	..	7.20	8.07	2.08			1.90	17.07
7033	.. 925 .....	..	6.40	3.72	2.78		1.60	1.56	16.55
7034	.. 926 .....	..	6.85	2.15	2.60		1.84	2.24	14.49
7035	.. 927 .....	..	7.90	5.17	1.68		.96	.87	16.63

7086	..	928	..	..	..	..	..	9.85	2.70	1.80	1.64	2.08	18.70
7087	..	929	..	..	..	..	..	18.50	2.18	1.72	.....	.....	15.68
7088	..	930	..	..	..	..	..	6.25	6.88	1.82	.....	.....	12.58
7089	..	931	..	..	..	..	..	6.85	5.86	6.04	.....	2.28	15.09
7090	..	932	..	..	..	..	..	6.00	6.09	7.48	1.40	1.49	17.50
7041	..	933	..	..	..	..	..	5.85	3.81	4.54	1.80	2.82	16.46
7042	..	934	..	..	..	..	..	6.45	4.46	4.04	1.58	1.49	16.82
7043	..	935	..	..	..	..	..	8.15	2.64	1.76	2.02	1.87	18.32
7044	..	936	..	..	..	..	..	8.15	3.89	2.76	1.46	1.76	17.89
7045	..	937	..	..	..	..	..	18.40	5.84	1.08	.....	.....	18.74
7046	..	938	..	..	..	..	..	8.50	5.84	2.68	1.10	1.12	18.04
7047	..	939	..	..	..	..	..	7.80	2.90	8.20	2.20	2.11	18.77

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Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value
			Nitrogen.	PHOSPHORIC ACID			Potash.	
				Water Soluble.	(Nitrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Mobile Acid Phosphate & Potash, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	8-10	2-4	2-3	1-2	\$ 11 16
"	Mobile Dissolved Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	8-10	2-4	2-3	2-3	12 17
"	Mobile Alkali Bone Phosphate, manufactured by Mobile Phos- phate Company, Mobile, Ala.	200	.....	8-8	2-4	2-3	4-5	12 17
"	Mobile Ammoniated Fertilizer, manufactured by Mobile Phos- phate Company, Mobile, Ala.	200	2.08-3	7-9	2-4	15-2	1-2	15 77- 28 40
"	Genuine German Kainit, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	.....	.....	.....	12-13	12 13
"	Mobile 446 Special Truck, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	3.80-4.50	3-4	1-3	1-2	4-8	19 24- 26 60
"	Mobile H. G. Truck Fertilizer, manufactured by Mobile Phos- phate Company, Mobile, Ala.	200	60-8	4-5	2-3	1-2	4-6	28 48- 36 40
"	L. X. L. Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	10-12	2-3	2-3	.....	12 14
"	English Acid Phosphate, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	12-13	2-3	2-3	.....	14 16 20 00
"	Mobile Standard Guano, manufactured by Mobile Phosphate Com- pany, Mobile, Ala.	200	1.65-2.05	6-7	2-3	1.50-2	2-3	14 62-

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Oct.	K.K.K. Ammoniated Soluble Bone, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.86-1.25	8-10	2-3	1.50-2	1-2	13 88-
..	Eclipse Soluble Guano, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	1.85-2.05	7-8	2-3	1.50-2	1-2	18 50-
..	Mobile Soluble Bone and Potash, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	.....	8-10	2-3	2-3	8-4	14 42-
..	Mobile Double Eagle Guano, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	1.65-2.50	7.50-8.50	2.50 1.50-2	2-3	8-4	18 00-
..	Rhodes Blood and Bone, manufactured by Mobile, Phosphate Company, Mobile, Ala.	200	1.65-2.50	6-7	2-3	1.50-2	2-3	17 00-
..	Mobile Blood Bone and Potash Compound, manufactured by Mobile Phosphate Company, Mobile, Ala.	200	1.65-2.50	6-7	2-3	1.50-2	2-3	15 62-
..	Patapasco Guano Co's XX Acid Phos and Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	8	2	2	4	21 00-
..	Acid Phos and 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	5	3	2	4	14 62-
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	8	3	2	2	20 00
..	Acid Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	10	2	2	1	14 00
..	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	11	2	2	.....	18 00
..	Mastodon Ammo. Soluble Phos., manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	8	2	2	13 00
..	Georgia Formula, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	1	1	2	16 62
..	Mascot Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.82	8	2	2	1	14 62
..	XX Acid Phosphate with Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	8	2	2	4	13 30
..	Acid Phosphate with 4% Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	5	3	2	4	14 00
..	Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	8	2	2	2	12 00



Guaranteed Analyses of Commercial Fertilizers, Filled in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received-	Name of Fertilizer or Chemical, by Whom Manufactured. and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble	Potash.	
1900								
Oct. 1	Acid Phosphate, manufactured by Georgia Chemical Works, Au- gusta, Ga.	200	.....	10	2	2	1	\$18 00
"	Dissolved Bone Phosphate, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	11	2	2	....	18 00
"	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	.....	.....	.....	48	48 00
"	Genuine German Kainit, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	.....	.....	.....	12	12 00
"	Patapasco Guano Company's Patapasco Guano, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	8	2	2	16 62
"	Ammoniated Dissolved Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	7	1	1	2	14 62
"	Baltimore Soluble Bone, manufactured by Georgia Chemical Works, Augusta, Ga.	300	.82	9	2	2	1	18 80
"	Muriate of Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	.....	.....	.....	48	48 00
"	Genuine German Kainit, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	.....	.....	.....	12	12 00
"	Pon Pon Crop Grower—Patapasco Guano Co's, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.00	7	8	1	2	14 80

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Sea Gull Guano, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.00	7	8	1	2	14 80
Md. Am. Dias. Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	1.65	6	8	1	1	14 82
12% Dissolved Bone and Potash, manufactured by Georgia Chemical Works, Augusta, Ga.	200	.....	10	2	1.50	.....	12 00
High Grade Blood and Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	7	.....	8	8	.....	22 80
Special, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	7.50	.....	2 50	2.50	.....	28 50
Fine Ground Beef Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	2.50	.....	12 50	12.50	.....	19 50
Pure Raw Bone Meal, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	4	.....	6	7	.....	17 20
Acidulated Animal Bone, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	2	.....	12 50	4.50	8	22 60
Ammoniated Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas.	200	2.50	8	4	8	1	15 00
Blood, Bone and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kas.	167	4	6	8	2	7	27 20
Fertiliz. No. 583, manufactured by Armour Fertilizer Works, Kansas City, Kas.	16	4	5	8	2.50	8	22 20
Fertilizer No. 386, manufactured by Armour Fertilizer Works, Kansas City, Kas.	16	2.50	5	8	2	6	21 00
Fertiliz. No. 386, manufactured by Armour Fertilizer Works, Kansas City, Kas.	16	1.50	5.50	2.50	1.50	5	17 62
Fertilizer No. 281, manufactured by Armour Fertilizer Works, Kansas City, Kas.	167	1.50	5.50	2.50	1.50	2	14 62
Fertilizer No. 272, manufactured by Armour Fertilizer Works, Kansas City, Kas.	167	1.50	5.50	2.50	1.50	1	18 62
Fertilizer No. 271, manufactured by Armour Fertilizer Works, Kansas City, Kas.	167	1.50	5	2	1.50	2	18 62
Fertilizer No. 271, manufactured by Armour Fertilizer Works, Kansas City, Kas.	167	1.50	8	2	1.50	1	18 62

**Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.**

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSES						Relative Commercial Value
			Nitrogen.	PHOSPHORIC ACID.			Potash.		
				Water Soluble.	Citrate Soluble.	Acid Soluble.			
1800	African Cotton Grower, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	2.50	5	4	1	3	\$ 19 00	
Oct. 1	Potato Fertilizer, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	3.50	3.50	2.50	1	4	19 40	
..	Fertilizer No. 721, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	1.50	4	3	1.50	1	12 20	
..	Fertilizer No. 722, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	1.50	4	3	1.50	2	13 20	
..	Fertilizer No. 821, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	1.50	4	3	1.50	1	13 20	
..	Fertilizer No. 822, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	1.50	5	3	1.50	2	14 20	
..	Armco D. B. and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	1.50	6.50	3.50	2	2	16 20	
..	Acid and Potash, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	167	.....	7	3	1.50	2	12 00	
..	Acid Phosphate, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	487	.....	6	2	1	4	12 00	
..	Acid Phosphate, manufactured by Armour Fertilizer Works, Kansas City, Kansas.	200	.....	8	4	2	.....	12 00	

Old Plantation Guano, manufactured by Union Fertilizer Co., Atlanta, Ga.	187	1.64.7	6	2	2	2	14 61
Union Cotton Grower, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	1.64.7	6	2	2	2	14 61
Dixie Guano, manufactured by Union Fertilizer Company, Atlanta, Ga.	200	1.64.7	6	2	2	2	14 61
Animal Bone and Peruvian Compound, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	82.4	7	8	2	1	18 31
Merrimac Guano, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	1.61.7	6	2	2	2	14 61
Blood, Bone and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	82.4	7	8	2	1	18 31
Free Silver 16 to 1 Compound, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	82.4	7	8	2	1	18 31
U. C. Dis. Bone, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	7	8	2	2	12 00
Union Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	7	8	2	2	12 00
Dixie Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	7	8	2	2	12 00
Merrimac Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	7	8	2	2	12 00
Union Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	7	8	2	2	12 00
Dixie Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	9	8	2	.....	12 00
Merrimac Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	9	8	2	.....	12 00
Bone and Potash Mixture, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	9	8	2	.....	12 00
	200	.....	6	2	2	4	12 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.						Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.		
				Water Soluble.	Citrate Soluble.	Acid Soluble.			
1900									
Oct. 1	Union High Grade Acid Phosphate and Potash, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	.....	6	2	2	2	2	\$10 00
..	Taylor's Anti-Sharp-shooter, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	82.4	7	3	2	1	1	13 81
..	Star Brand, manufactured by Union Fertilizer Company, Atlanta, Ga.	200	82.4	7	3	2	1	1	13 31
..	U. C. Potash Acid Phosphate, manufactured by Union Fertilizer Co., Atlanta, Ga.	200	1.647-2.47	6	2	2	4	4	12 00
..	Read's Soil Food, manufactured by Read Phosphate Co., Nashville, Tenn.	200	82-1 64	6-8	2-3	1-2	2-3	2-3	14 61
..	Farmer's Special Manure, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.647-2.47	8-10	2-3	1-2	3-4	3-4	15 30
..	Read's Cotton Flower, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.647-2.47	6-8	3-4	1-2	3-4	3-4	16 60
..	Wynn's Pacific Guano, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.647-2.47	6-8	2-3	1-2	1-2	1-2	13 60
..	Read's Blood and Bone, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.647-2.47	6-8	2-3	1-2	1-2	1-2	13 60
..	Read's Matchless Cotton Grower, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.647-2.47	6-8	2-3	1-2	1-2	1-2	13 61

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Read's Farmers' Friend Fertilizer, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.047-2.47	6-8	8-4	1-2	1-2	14 61
Read's Blood, Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.82-1.047	6-8	2-3	1-2	1-2	13 30
Read's Blood and Bone and No. 1, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.047-2.47	6-8	2-3	1-2	2-3	14 61
Read's Blood and Bone Special, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.82-1.047	7-10	3-4	1-2	1-2	13 30
Read's Alkaline Bone, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-10	2-3	1-2	2-3	12 00
Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-10	2-3	1-2	2-3	12 00
Read's Special Potash Mixture, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-10	2-3	1-2	4-6	14 00
Read's Acid Phosphate and Pot., manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	6-8	2-3	1-2	4-6	12 00
Read's Matchless Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	10-12	2-3	2-3	...	12 00
Read's XXX Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	10-12	3-4	2-3	.....	13 00
Read's High Grade Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	10-12	4-5	2-3	.....	14 00
Read's H. G. Amo. Dissolved Bone, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.047-2.47	8-10	2-3	1-2	2-3	16 61
Satin Staple Guano, manufactured by Read Phosphate Co., Nashville, Tenn.	200	2.05-8.07	6-8	4-6	2-3	2-3	17 75
Missing Link Guano, manufactured by Read Phosphate Co., Nashville, Tenn.	200	1.02-1.56	6-8	4-6	2-3	2-3	14 85
Up to Date Guano, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.823-1.28	6-8	4-6	2-3	1-2	13 30
Peterkin's Improved Formula, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-10	4-6	2-3	2-3	14 00
Dissolved Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	6-7	4-5	2-3	2-3	12 00

Guaranteed Analyses of Commercial Fertilizers, filed in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers,

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEE ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1960								
Oct. 1	Available Bone Acid Phosphate, manufactured by Read Phos- phate Co., Nashville, Tenn.	200	.....	9-10	5-6	2-3	.....	\$ 14 00
"	Electric Acid Phosphate, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-9	4-5	2-3	.....	12 00
"	Read's Bone and Potash, manufactured by Read Phosphate Co., Nashville, Tenn.	200	.....	8-10	2-3	10-12	2-3	12 00
"	Adair's Acid Phosphate, manufactured by A. D. Adair and Mc- Carty Bros., Atlanta, Ga.	200	.....	7-9	3-4	2-4	.....	10 00- 13 00
"	Acid Phosphate and Pot., manufactured by A. D. Adair and Mc- Carty Bros., Atlanta, Ga.	200	.....	7-9	3-4	2-4	1-2	11 00- 14 00
"	Ammoniated Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	1.75-	5-8	3-4	2-4	2-3	14 90- 17 00
"	Adair's Soluble Pacific Guano, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	2.50	7-8	3-4	2-4	2-3	16 60
"	Planters' Soluble Fertilizer, manufactured by A. D. Adair and Mc- Carty Bros., Atlanta, Ga.	300	1.75-	5-8	3-4	2-4	2-3	14 90- 19 00
"	McCarty's Soluble Bone, manufactured by A. D. Adair and Mc- Carty Bros., Atlanta, Ga.	200	2.50	7-8	3-4	2-4	2-3	17 00
"	Adair's Special Potash Mixture, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	88- 1.25	7-8	3-4	2-4	1-2	18 88- 20 00
"	Adair's Special Potash Mixture, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	.....	5-8	3-4	2-4	4-6	12 00- 15 00

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Adair's Formula, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	7-9	8-4	2-4	2-3	12-00
McCarty's Potash Formula, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	7-9	8-4	2-4	2-3	15 00
Special Bone and Potash Compound, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	7-8	8-4	2-4	4-6	14 00
Adair's Soluble Bone and Potash, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	7-8	8-4	2-4	2-3	17 00
Adair's H. G. Dissolved Bone, manufactured by A. D. Adair and McCarty Bros., Atlanta, Ga.	200	9-12	8-4	2-4	.....	12 00
Furman Acid Phosphate, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	7-9	8-4	2-4	.....	15 00
Furman Acid Phosphate and Potash, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	7-9	8-4	2-4	.....	10 00
Furman High Grade Fertilizer, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	7-8	8-4	2-4	1-2	11 00
Buffalo Bone Fertilizer, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	5-8	8-4	2-4	2-3	18 80
Furman Soluble Bone, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	7-8	8-4	2-4	1-2	14 90
Furman's H. G. Dissolved Bone, manufactured by Furman Farm Improvement Co., Atlanta, Ga.	200	7-9	8-4	2-4	2-3	19 88
Swift's Special G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga.	200	9-12	8-4	2-4	.....	12 00
Swift's Monarch H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga.	200	7-9	8-4	2-4	2-3	15 00
Swift's Cotton King H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga.	200	7-9	8-4	2-4	2-3	12 00
Swift's Eagle H. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga.	200	7-9	8-4	2-4	2-3	15 00
Swift's Golden Harvest S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga.	200	6-6	2-4	1-3	2	16 62



**Guaranteed Analyses of Commercial Fertilizers, Filled in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers.**

When Received.	Name of Fertilize. or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	GUARANTEED ANALYSIS.					Relative Com- mercial Value
			Nitrogen.	PHOSPHORIC ACID			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Swift's Pioneer S. G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	1.24	7-9	2-4	1-3	1	\$ 14 47
..	Swift's Cotton Plant S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta Ga	200	1.65	7-9	2-4	1-3	1	14 62
..	Swift's Plow Boy S G. Guano, manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.82	7-9	2-4	1-3	1	18 80
..	Swift's Homestead H. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.....	8-10	2-4	1-3	4	14 00
..	Swift's Plantation S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.....	8-10	2-4	1-3	4	14 00
..	Swift's Wheat Grower S. G. P. & P., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.....	8-10	2-4	1-3	2	12 00
..	Swift's Atlanta L. G. P. & P., manufactured by Swift's Fertilizer Works. Atlanta, Ga	200	.....	8-10	2-4	1-3	1	11 00
..	Swift's Capital H. G. A. Phos., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.....	10-12	2-4	1-3	.....	14 00
..	Swift's Chattahoochie S. G. A. Phos., manufactured by Swift's Fertilizer Works, Atlanta, Ga	200	.....	10-12	2-4	1-3	.....	12 00

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1900		200	1.65	6-8	2-4	1-8	2	14.62
Oct. 1	Swift's Empire Sd. Guano, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	1.65	6-8	2-4	1-8	2	14.62
"	Swift's Dixie Sd. Phos. and Pot., manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	.....	8-10	2-4	1-8	2	12-00
"	Swift's German Kainit, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	100	.....	.....	.....	.....	12	11 00
"	Swift's Ground Bone and Blood, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	18.18	16%	Amo.	.....	.....	36 00
"	Swift's Muriate Potash, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	.....	.....	.....	.....	50	50 00
"	Swift's Ground Tankage, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	7.81	Amo.	.....	9%	.....	22 46
"	Swift's Nitrate of Soda, manufactured by Swift's Fertilizer Co., Atlanta, Ga.	200	15.65	Amo.	.....	19%	.....	43 88
"	Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.....	6	4	1	2	12 00
"	Eagle Ammoniated Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	1.65	6	2	1	2	14 62
"	Eagle Beef, Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.82	7	8	1	1	18 29
"	Teague's Beef Blood and Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.82	7	8	1	1	18 29
"	Teague's Bone and Potash, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.....	7	8	1	2	12 00
"	Teague's Acid Phos., manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.....	8	4	1	.....	12 00
"	Eagle Guano, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	1.65	7	8	1	2	16 62
"	Eagle Dissolved Bone, manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.....	10	4	1	.....	14 00
"	Eagle Acid Phos., manufactured by Louisville Fertilizer Co., Louisville, Ky.	200	.....	6	4	1	.....	12 00
"	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	.....	7	8	1	4	14 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID			Potash.	
				Water Soluble.	(Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Ox Potash Special, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.....	6	2	1	4	\$ 12 00
"	Ox Potash Formula, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.....	8	2	1	4	14 00
"	Ox H. G. Amoniaded Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	1.65	6	4	1	2	16 62
"	Ox Cotton Grower, Manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	1 65	6	4	1	1	15 62
"	Ox Special Wheat and Corn Guano, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.85	9	3	1	1	15 88
"	Ox Bone with Ammonia and Potash, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.85	6	4	1	1	13 88
"	Ox Slaughter House Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	1.65	6	2	1	2	14 62
"	Ox H. G Diss Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.....	8	6	1	.....	14 00
"	Ox Alkaline Bone, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.....	9	3	1	2	14 00
"	Ox Bone and Potash, manufactured by Tennessee Chemical Co., Nashville, Tenn .....	200	.....	7	5	1	1	13 00

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Ox Potash Mixture, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	.....	8	2	1	2	12 00
Ox Acid Phosphate, manufactured by Tennessee Chemical Co., Nashville Tenn.	200	.....	7	5	1	.....	12 00
Ox Potash Acid, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	.....	8	2	1	1	11 00
Ox Special Truck Guano, manufactured by Tennessee Chemical Co., Nashville, Tenn.	200	3 30	8	2	1	4	28 24
Complete Fertilizer, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1 70	7	2	2	2	15 76
Truck Farmer's Friend, manufactured by Scholze Bros., Chattanooga, Tenn.	200	1 70	7	2	2	4	17 76
Acid Phosphate, manufactured by Scholze Bros., Chattanooga, Tenn.	200	.....	12	2	1	.....	14 00
Marietta H. G. Acid Phosphate, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	12-14	2-3	2-3	1 25-	16 10
Marietta H. G. Acid Phosphate with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	8-10	2-3	2-3	2 25	18 13
Piedmont Acid Phosphate, manufactured by Marietta Guano Co., Atlanta Ga.	200	.....	10-12	2-3	2-3	.....	18 80
Magic Cotton Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	8-10	2-3	2-3	1-2	16 00
Beef Blood and Bone Compound, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	8-9	2-3	1-3	1 25-	16 65
Dissolved Bone with Potash, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	7-9	2-3	2-3	2-4	12 95
Same for Wheat, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	7-9	2-3	2-3	2-4	12 95
Wheat and Clover Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	10-12	2-3	2-3	2-4	16 40
Golden Grain Grower, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	8-9	2-3	2-3	4-6	14 40
M. Y. C. H. G. Dis. Bone, manufactured by Marietta Guano Co., Atlanta, Ga.	200	.....	8-10	2-3	2-3	2-4	14 10

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Planters Pride Guano, manufactured by Marietta Guano Co., Atlanta, Ga. ....	200	1.75	7	2	1-8	1.25-2.25	17 50
..	Solid South Guano, manufactured by Marietta Guano Co., Atlanta, Ga. ....	200	1.75	7	2	1-8	1.25-2.25	17 58
..	Lee Fertilizer, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	1.75	8	1	2	2.00	15 90
..	XX Blood and Bone, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	1.00	8	1	2	1.00	12 80
..	High Grade Guano, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	1.50	7	2	2	1.75	14 95
..	Old Time Guano, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	1.25	7	1	2	1.00	12 50
..	XXX Ammoniated Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	.82	8	1	2	1.00	12 29
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	.....	12	1	2	.....	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	.....	10	2	2	1	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala. ....	200	.....	10	2	1	1	12 00

..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	9	2	2	2	18 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	9	1	2	2	12 00
..	Dissolved Bone and Potash, manufactured by Trawick & Jernigan, Opelika, Ala.	200	9	1	2	8	18 00
..	Dissolved Bone and Potash manufactured by Trawick & Jernigan, Opelika, Ala.	200	8	1	2	8	12 00
..	H. G. English Acid, manufactured by Trawick & Jernigan, Opelika, Ala.	200	12	2	2	2	14 00
..	Dissolved Bone, manufactured by Trawick & Jernigan, Opelika, Ala.	200	11	1	2	.....	12 00
..	Dale County Standard Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	7	2	1	2	16 80
..	Ozark High Grade Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	7	2	1	2	16 80
..	Complete Cotton Fertilizer, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	6	1.70	1	2	14 62
..	Ozark High Grade Phosphate, manufactured by Ozark Cotton Seed Oil Mill Fertilizer Co., Ozark, Ala.	200	8	11	2	.....	14 00
..	English Acid Phosphate, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	11	3	.....	.....	14 00
..	Blood and Bone, McDonald, imported by Troy Fertilizer Co., Troy, Ala.	200	7	2	.....	2	15 62
..	English Dissolved Bone, Buford & Co., imported by Troy Fertilizer Co., Troy, Ala.	200	11	8	.....	.....	14 00
..	Dissolved Bone and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	7	2	.....	8	18 00
..	Acid Phosphate and Potash, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	7	2	.....	8	12 00
..	German Kainit, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	10 50	2 50	.....	12	12 00
..	The Troy Acid Phosphate, manufactured by The Troy Fertilizer Co., Troy, Ala.	200	10 50	2 50	.....	.....	18 00

**Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.**

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	H. G. Acid Phosphate, manufactured by the The Troy Fertilizer Co., Troy, Ala.....	200	.....	1:	8	.....	.....	\$ 14 00
..	Pelican R. B Guano, manufactured by Standard G & C. Mfg. Co., New Orleans, La.....	100-	1.65-	4-5	4-5	.....	1.50-3	
..	Miss. Home Guano, manufactured by G. & G. Mfg. Co., New Orleans, La.....	200	2.50	4-5	4-5	.....	24.25	
..	Blood, Bone and Meat Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	100-	1.65-	8.25	5-6.50	.....	24.25	
..	Stern's Am. R. B. Sup. Phos, manufactured by Standard G. & C. Mfg Co, New Orleans. La.....	200	1.70-	4-8	4.25-	.....	24.25	
..	Standard Am. Sol. Guano, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	100-	1.65-	4-5	5.00-	.....	1.50-3	
..	Champion Farmers' Choice, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	200	2.50	4-5	4-5	.....	1.50-3	
..	Ground Bone, manufactured by Standard G. & C. Mfg Co., New Orleans La.....	100-	1.65-	4-5	4-5	.....	1.50-3	
..	Dissolved Bone, manufactured by Standard G. & C. Mfg. Co., New Orleans La.....	200	3.50	4-5	4-5	.....	1.50-3	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	100-	1.65-	4-5	4-5	.....	1.50-3	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	200	2.50-	4-5	4-5	.....	18.50-	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	100-	8.25	.....	.....	21.00	.....	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	200	.....	13-14	2-5	.....	.....	
..	Acid Phosphate, manufactured by Standard G. & C. Mfg. Co., New Orleans, La.....	100-	.....	10-12	2-4	.....	.....	

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Guaranteed Analyses of Commercial Fertilisers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received-	Name of Fertilizer or Chemical, by Whom Manufactured. and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1800								
Oct. 1	Meridian English Phos. manufactured by Meridian Fertilizer Factory, Meridian, Mississippi	200	.....	8.00	2.00	1.00	.....	\$12 00
..	Bowker Cotton Fertilizer, manufactured by Bowker Fertilizer, Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Naston Guano. manufactured by Bowker Fertilizer Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Crown Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Sure Crop Fertilizer, manufactured by Bowker Fert. Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Dis. Bone Phos., manufactured by Bowker Fert. Co., Eliza- beth, N. J.	200	.....	10	2	2	.....	12 00
..	Bowker Dis. Bone with Potash, manufactured by Bowker Fert. Co., Elizabeth, N. J.	200	.....	8	2	2	2	12 00
..	Kainit, manufactured by Bowker Fertilizer Company, Elizabeth, N. J.	.....	.....	.....	.....	.....	12	12 00
..	Ashpoo Fert., manufactured by Ashpoo Fertz. Co., Charleston, S. C.	200	1.75	6 25	2 25	2 00	1.00	14 40
..	Eutaw Fertilizer, manufactured by Ashpoo Fertz. Co., Charles- ton, S. C.	200	1.75	6 25	2 25	2 00	1.00	14 40



Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received-	Name of Fertilizer or Chemical, by Whom Manufactured. and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble	Potash.	
1900								
Oct. 1	Meridian English Phos. manufactured by Meridian Fertilizer Factory, Meridian, Mississippi	200	.....	8.00	2.00	1.00	.....	\$12 00
..	Bowker Cotton Fertilizer, manufactured by Bowker Fertilizer, Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Naston Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Crown Guano, manufactured by Bowker Fertilizer Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Sure Crop Fertilizer, manufactured by Bowker Fert. Co., Elizabeth, N. J.	200	1.65	6	2	2	1	14 62
..	Bowker Dis. Bone Phos., manufactured by Bowker Fert. Co., Eliza- beth, N. J.	200	.....	10	2	2	.....	12 00
..	Bowker Dis. Bone with Potash, manufactured by Bowker Fert.Co., Elizabeth, N. J.	200	.....	8	2	2	2	12 00
..	Kainit, manufactured by Bowker Fertilizer Company, Elizabeth, N. J.	.....	.....	.....	.....	.....	12	12 00
..	Ashpoo Fert., manufactured by Ashpoo Ferts. Co., Charleston, S. C.	200	1.75	6.25	2.25	2.00	1.00	14 40
..	Eutaw Fertilizer, manufactured by Ashpoo Ferts. Co., Charle- ston, S. C.	200	1.75	6.25	2.25	2.00	1.00	14 40

Oct. 1	Ashepool Guano, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	2.10	6.00	2.00	1.00	1.00	14.88
..	Eutaw Flood and Bone Guano, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.85	6.00	2.00	8.00	1.00	11.88
..	Ashepool Blood and Bone Guano, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.85	6.00	2.00	8.00	1.00	11.88
..	Ashepool Dia. Bone with Am. and Potash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.85	6.00	2.00	8.00	1.00	11.88
..	Eutaw Guano, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	1.75	6.25	2.25	2.00	2.00	15.40
..	Enon Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	2.00	2.00	12.50
..	Pioneer Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	2.00	1.00	11.50
..	Ashepool Bone Ash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	1.00	1.00	11.50
..	Ashepool XX Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	9.50	2.50	2.00	.....	12.00
..	Eutaw XX Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	9.50	2.50	2.00	.....	12.00
..	Bronwood Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	6.00	2.00	2.00	4.00	12.00
..	Eutaw Acid with Potash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	2.00	1.00	11.50
..	German Kainit, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	.....	.....	.....	11.00	11.00
..	Carolina Acid Phos., manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	6.00	2.00	2.00	4.00	12.00
..	Coomassie A. P. with Potash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	9.50	2.50	1.00	2.00	14.00
..	Ashepool Acid Phos. with Potash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	2.00	1.00	11.50
..	Ashepool Acid Potash, manufactured by Ashepool Fertz. Co., Charleston, S. C.	200	.....	8.50	2.00	1.00	.....	10.50

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Eutaw Acid Phosphate, manufactured by Ashepoo Fertilizer Co., Charleston, S. C.	200	.....	8.50	2.00	1.00	.....	10.50
..	Coomassie Acid Phosphate, manufactured by Ashepoo Fertilizer Co., Charleston, S. C.	200	.....	9.50	2.50	2.00	.....	12.00
..	Blood and Bone and Potash, manufactured by New Orleans Acid and Chemical Co., New Orleans, La.	200	.823	7.00	3	2	1	13.80
..	Acid Phosphate with 4% Potash, manufactured by Potapoco Guano Co., Baltimore, Md.	200	.....	5.00	3	2	4	12.00
..	Ammoniated Dissolved Bone and Potash, manufactured by Dothan Guano Co., Dothan, Ala.	200	.823	8.00	2	2	2	14.80
..	Standard Grade Corn and Cotton Compo., manufactured by Do- than Guano Co., Dothan, Ala.	200	1.65	7.00	2	1	2	15.62
..	Standard Grade Grange Mixture, manufactured by Dothan Guano Co., Dothan, Ala.	200	1.65	5.50	2	1	3	15.12
..	Peterman's Leader, manufactured by Dothan Guano Co., Dothan, Ala.	200	.82	8.00	2	1	1	13.80
..	Grange Mixture, manufactured by Dothan Guano Company, Do- than, Ala.	200	1.65	5.50	1.25	1	3	14.87
..	Corn and Cotton Compound, manufactured by Dothan Guano Co., Dothan, Ala.	200	1.65	7.00	1.00	1	2	14.62

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Howell's Fruit Food, manufactured by Dothan Guano Company, Dothan, Ala.	200	1.50	5.50	2.00	1	8.1-2	15 20
Phosphate with 3% Potash, manufactured by Dothan Guano Co., Dothan, Ala.	200	.....	8.00	1.50	1	3	12 50
High Grade Acid Phosphate, manufactured by Dothan Guano Co., Dothan, Ala.	200	.....	11.00	2.00	1	.....	13 00
Blood and Bone Fertilizer, manufactured by Dothan Guano Co., Dothan, Ala.	200	1.65	7.00	2.00	1	2	15 62
Ammoniated Dissolved Bone, manufactured by Dothan Guano Co., Dothan, Ala.	200	.82	8.00	2.00	1	1	18 80
Genuine German Kainit, manufactured by Dothan Guano Co., Dothan, Ala.	200	.....	.....	.....	.....	12%	12 00
B. D. Seafowl Guano, manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	1.85	6.50	2.50	2.00	1.00	15 18
Bradley's Patent Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	1.85	6.50	2.50	2.00	1.00	15 18
Ammoniated Dissolved Bone, manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
Eagle Arm Bone Superphosphate, manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62
Bradley's Palmetto Acid Phosphate manufactured by Bradley Fertilizer Co., Charleston, S. C.	200	.....	9.00	3.00	2.00	.....	12 00
Cow Phosphate Acid, manufactured by Cullman Cotton Company, Cullman, Ala.	200	.....	12-13	1-2	2-3	.....	18 00
Bull Phosphate Acid, manufactured by Cullman Cotton Company, Cullman, Ala.	200	.....	12-14	2-4	1-3	.....	11 00
Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.82-100-1	.....	.....	10-11	1.1-15	18 90
Cow Guano, manufactured by Cullman Cotton Company, Cullman, Ala.	200	1.65-2	.....	.....	10-12	1.1-15	15 62
Guano No. 8-P, manufactured by Cullman Cotton Company, Cullman, Ala.	200	.....	8	2	..	4	14 00
Guano No. 3-S, manufactured by Cullman Cotton Company, Cullman, Ala.	200	1.65	6	2	.....	2	14 62

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture, by Dealers and Manufacturers.

When Received.	Name of Fertilizer, or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900								
Oct. 1	Best Made, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	1.17	2	\$16 62
"	Cow Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8.21	1.79	1.82	1	15 62
"	Corn and Cotton Guano, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.82	7.85	2.65	1.83	1	18 80
"	Cow Acid Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.....	12%	1%	2%	.....	15 00
"	Bull Acid Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.....	12%	2%	1%	.....	14 00
"	No. 5 B Phosphate, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	7	2	.....	2	15 62
"	No. 6 A., manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.50	7	2	.....	2	15 20
"	No. 9 C., manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	.....	1	15 62
"	Guano 16. P., manufactured by Cullman Cotton Co., Cullman, Ala.	200	.....	12	.....	.....	4	16 00
"	Mountain City Lint, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.82	6	4	1	4	16 80

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Oct. 1	Mountain City Lint, No. 2, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	6	4	1	4	18 80
..	Corn and Cotton Lint No. 2, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	10	2	.....	2	18 80
..	No. 1024, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	1	4	18 80
..	No. 735, manufactured by Cullman Cotton Co., Cullman, Ala.	200	2.50	6	1	1	5	19 00
..	No. 1094, manufactured by Cullman Cotton Co., Cullman, Ala.	200	2.50	8	2	1	4	21 00
..	No. 1028, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	1	3	17 62
..	No. 828, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	6	2	1	3	15 82
..	No. 822, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	6	2	1	2	14 62
..	No. 1022, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	1	2	19 62
..	No. 922, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	7	1.50	1	2	15 12
..	No. 1021, manufactured by Cullman Cotton Co., Cullman, Ala.	200	1.65	8	2	1	1	15 62
..	No. 1014, manufactured by Cullman Cotton Co., Cullman, Ala.	200	.82	8	2	1	4	16 80
..	Acid and Potash No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	8	2	2	2	12 00
..	Acid and Potash No. 12-2, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	8	4	2	2	14 00
..	Acid and Potash No. 4, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	6	2	2	4	12 00
..	Home Mixture No. 1, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	7	2	2	1	14 62
..	Home Mixture No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	6	2	2	2	14 62



Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	GUARANTEED ANALYSES						Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.					
				Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.		
1900									
Oct. 1	Home Mixture No 3, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	8	2	2	2	2	\$ 16 62
..	Home Mixture No 4, manufactured by Home Mixture Guano Co Columbus, Ga.	200	1.65	6	2	2	2	4	16 62
..	Acid Phosphate No 1, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	10	2	2	2	.....	12 00
..	Acid Phosphate No. 2, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	12	2	2	2	.....	14 00
..	Potatoe Mixture, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	1.65	4	2	1	6	6	16 62
..	Kainit, manufactured by Home Mixture Guano Co., Columbus, Ga.	200	.....	.....	.....	.....	12	12	12 00
..	Goldsmith Imported Mixture, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	1.00	1.00	14 62
..	Gold Dust, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	1.00	1.00	14 62
..	Blood, Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	2.00	1.00	14 62
..	Good Luck, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.	200	1.65	7.00	2.00	2.00	2.00	1.00	14 62
..	Co., Gretna, La.	200	1.65	7.00	2.00	2.00	2.00	1.00	14 62

..	Dixie Soluble Bone and Potash with Ammonia, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.....	200	1.65	6.00	1.00	2.00	1.00	12.62
..	Dis. Bone and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.....	200	....	8.00	2.00	2.00	2.00	12.00
..	Acid and Potash, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.....	200	....	8.00	2.00	2.00	4.00	14.00
..	Black Diamond Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.....	200	....	10.00	2.00	2.00	....	12.00
..	Crescent City Acid Phosphate, manufactured by New Orleans Acid and Fertilizer Co., Gretna, La.....	200	....	10.00	2.00	2.00	....	12.00
..	W. O. C. A. Pure Blood Guano, manufactured by Coweta Fertilizer Co., Newnan and Columbus, Ga.....	167	1.65	8	2	1	2	16.62
..	Coweta H. G. Fertilizer, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	1.65	8	2	1	2	16.62
..	Coweta Animal Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	1.65	6	2	1	2	14.62
..	Sea Bird Guano manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	1.65	6	2	1	2	14.62
..	Aurora Amo. Phosphate, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	1.65	7	2	1	1	14.62
..	Coweta Stand. Dis. Bone and Potash, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	8	2	1	2	12.00
..	Coweta Wheat and Grass Grower, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	8	2	1	2	12.00
..	Coweta H. G. Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	12	2	1	....	14.00
..	Coweta Standard Acid Phosphate, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	10	2	1	....	12.00
..	Coweta Diss. Bone, manufactured by Coweta Fertilizer Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	10	2	1	....	12.00
..	I. A. P. Bone with Ammonia and Potash, manufactured by Coweta Chemical Co., Branch Virginia-Car Chemical Co., Newnan, Ga.....	200	.83	8	2	1	1	18.81
..	18 & 14 Diss. Bone and Potash, manufactured by Coweta Fert. Co., Branch Virginia-Carolina Chemical Co., Newnan, Ga.....	200	....	11	2	1	4	17.00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS*					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900								
Oct. 1	10 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga. ....	200	.....	8	2	1	4	\$ 14 00
..	8 & 4 Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga. ....	200	.....	6	2	1	4	12 00
..	Coweta Dissolved Bone and Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga. ....	200	.....	10	2	1	2	14 00
..	German Kainit, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga. ....	200	.....	.....	.....	.....	12	12 00
..	Muriate of Potash, manufactured by Coweta Fert. Co., branch Virginia-Carolina Chemical Co., Newnan, Ga. ....	.....	...	.....	.....	.....	48	48 00
..	Old Dominion Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga. ....	200	1.65	6	2	2	1.50	14 12
..	Southern Amd. Dissolved Bone Guano, manufactured by Old Do- minion Guano Co., Atlanta, Ga. ....	200	1.65	6	2	2	1	18 62
..	Patent Pacific Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga. ....	200	1.65	6	2	2	1	18 62
..	Etowah Guano, manufactured by Old Dominion Guano Co., At- lanta, Ga. ....	200	.85	6	3	2	1	12 38
..	Blood and Bone Guano, manufactured by Old Dominion Guano Co., Atlanta, Ga. ....	200	.85	6	3	2	1	12 38
..	Co., Atlanta, Ga. ....	200	.85	6	3	2	1	12 38

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Old Dominion Dissolved Bone, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	.....	10	2	2	.....	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion, Guano Co., Atlanta, Ga.	200	.....	8	2	2	2	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	.....	6	2	2	4	12 00
Old Dominion Dissolved Bone and Potash, manufactured by Old Dominion Guano Co., Atlanta, Ga.	200	.....	8	2	2	4	14 00
Bear H. G. Dissolved Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	8	6	1	.....	14 00
Bear H. G. Beef Blood and Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	1.65	5	2	1	2	16 62
Bear Special Wheat and Corn Grower, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	8	8	1	2	18 00
Bear Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	9	8	1	1	18 00
Bear Potash mixture, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	8	2	1	2	12 00
Eddystone Soluble Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	1.85	7	2	1	1	14 62
Eddystone Dissolved Bone, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	10	8	1	.....	18 00
Eddystone Bone and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	7	5	1	1	18 00
Eddystone Potash Mixture, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	7	8	1	2	12 00
Sunny South Acid Phosphate, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	10	8	1	.....	18 00
Bear Phosphate and Potash, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.....	8	2	1	1	11 00
Eddystone Cotton Guano, manufactured by Continental Fertilizer Co., Nashville, Tenn.	200	.85	6	4	1	1	18 88
Etiwan H. G. Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	.....	11-18	2-3	2	.....	18 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.						Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.		
				Water Soluble.	Citrate Soluble.	Acid Soluble.			
1900	Etiwan Acid Phosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	.....	10-12	2	2	.....	12 00	
Oct. 1	Plow Brand haw Bone Superphosphate, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	6-8	2-3	2	2-3	14 60	
.	Diamond Soluble Bone, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	.....	11-13	2-3	2	.....	13 00	
.	Plow Brand Soluble Fertilizer, manufactured by Etiwan Fertilizer Co., Charleston, S. C.	200	1.64	7-9	2-3	2	1-2	14 60	
.	American Ammoniated Bone Superphosphate, manufactured by Williams & Clark Fertilizer Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62	
.	Cumberland Bone Superphosphate of Lime, manufactured by Cumberland Bone Phosphate Co., Charleston, S. C.	200	1.65	6.00	2.00	2.00	1.00	13 62	
.	Goulding's Vegetable Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	3.30	5	2	1	4	20 24	
.	Goulding's H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	12	3	1	.....	15 00	
.	Goulding's Atlas Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	10	3	1	.....	13 00	
.	Goulding's Mixture, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	10	2	1	.....	14 00	

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Genuine German Kainit, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	.....	.....	12	12 00
Goulding's H. G. Phosphate and Potash, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	10	2	1	18 00
Goulding's Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's Special Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's English Bone Compound, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's St. George Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's H. G. Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.85	7	2	1	12 88
A. G. Winkler's Ammoniated Dissolved Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	12	3	1	15 00
Gem Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
English Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	5	3	1	14 62
Samson Ammoniated Bone, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	9	3	1	12 00
Samson Acid Phosphate, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	1.65	6	3	1	15 12
Goulding's 3% Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	10	3	1	18 00
Goulding's 4% Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	6	2	1	11 00
Goulding's XXX Potash Acid, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	6	2	1	12 00
Tucker, Willingham & Co's Special H. G. Potash Guano, manufactured by The Goulding Fertilizer Co., Limited, Pensacola, Fla.	200	.....	12	2	1	16 00
	200	.85	7	3	1	15 88

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900			1.64-					
Oct. 1	Earle Terrell & Co. H. G. Fertilizer, manufactured by Birming- ham Fertilizer Co., Birmingham, Ala.	200	2.46	8-10	2-3	2	2-3	16 60
..	Earle Terrell & Co. H. G. Acid Phosphate, manufactured by Bir- mingham Fertilizer Co., Birmingham, Ala.	200	.....	11-13	2-3	2	.....	13 00
..	Earle Terrell & Co. Bone and Potash, manufactured by Birming- ham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	2-3	12 00
..	Madville Oil Mill H. G. Acid Phosphate, manufactured by Birming- ham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	...	12 00
..	Cahaba Acid Phos. and Pot. Mixture, manufactured by Birming- ham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	2-3	12 00
..	Cahaba Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	4-5	14 00
..	Cahaba Bone Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	6-8	2-3	2	4-5	12 00
..	Cahaba Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	6-8	2-3	2	1-2	11 80
..	Cahaba Dis. Bone Am. and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	1-2	18 80
..	Cahaba H. G. Blood, Bone and Potash, manufactured by Birming- ham Fertilizer Co., Birmingham, Ala.	200	1.64-	8-10	2-3	2	2-3	16 60

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..	Cahaba H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Cahaba Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 50
..	Cahaba Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 60
..	Birmingham H. G. Blood, Bone and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Birmingham H. G. Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Birmingham Soluble Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	7-9	2-3	2	1-2	14 60
..	Birmingham Standard Grade Fertilizer, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	6-8	2-3	2	2-3	14 60
..	Birmingham Dis. Bone A. M. and Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	82-100	8-10	2-3	2	1-2	18 80
..	Jefferson County Standard Guano, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	1.64-2.46	8-10	2-3	2	2-3	16 60
..	Cahaba Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	...	12 00
..	Cahaba H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	11-13	2-3	2	...	18 00
..	Cahaba Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	...	12 00
..	Cahaba H. G. Diss. Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	11-13	2-3	2	...	18 00
..	Cahaba Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	1-2	11 00
..	Birmingham Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	....	12 00
..	Birmingham H. G. Acid Phosphate, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	11-13	2-3	2	...	18 00
..	Birmingham Dissolved Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	...	12 00



Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Birmingham H. G. Dissolved Bone, manufactured by Birmingham, Fertilizer Co., Birmingham, Ala.	200	.....	11-13	2-3	2	.....	\$ 13 00
..	Birmingham Acid Phosphate with Potash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	1-2	11 00
..	Birmingham Acid Phosphate and Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	2-3	12 00
..	Birmingham Potash Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	8-10	2-3	2	4-5	14 00
..	Birmingham Bone and Ash, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	6-8	2-3	2	4-5	12 00
..	Birmingham D Bone and Murate Potash mixture, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	.....	10-12	2-3	2	2-3	14 00
..	Birmingham Soluble Bone, manufactured by Birmingham Fertilizer Co., Birmingham, Ala.	200	82-100	6-8	2-3	2	1-2	11 80
..	Navassa Cotton Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C.	200	1.65	6 00	2 00	2 00	2 00	14 62
..	Navassa Bone and Ash, manufactured by Navassa Guano Co., Wilmington, N. C.	200	.....	7 00	3 00	2 00	2 00	12 00
..	Dissolved Bone with Am. and Potash, manufactured by Navassa Guano Co., Wilmington, N. C.	2 00	.82	7 00	8 00	2 00	1 00	18 80

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Navassa Acid Phosphate, manufactured by Navassa Guano Co., Wilmington, N. C.	200	.....	9.00	3.00	2.00	....	12 00
Acid Phosphate with Potash, manufactured by Navassa Guano Co., Wilmington, N. C.	200	.....	7.00	8.00	2.00	1.00	11 00
Navassa Complete Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C.	200	1.65	6.00	3.00	2.00	1.00	14 62
Navassa Wheat Mixture, manufactured by Navassa Guano Co., Wilmington, N. C.	200	.....	7.00	3.00	2.00	4.00	14 00
Navassa Grain Fertilizer, manufactured by Navassa Guano Co., Wilmington, N. C.	200	1.65	6.00	2.00	2.00	2.00	14 62
Genuine German Kainit, manufactured by Navassa Guano Co., Wilmington, N. C.	200	.....	.....	.....	.....	12.00	12 00
Giant Guano, manufactured by Rasin Monumental Co., Rich- mond, Va.	200	1.65	6	2	2	2	14 62
Soluble Sea Island, manufactured by Rasin Monumental Co., Charleston, S. C.	200	1.65	6	8	2	1	14 62
Rasin's Empire Guano, manufactured by Rasin Monumental Co., Atlanta, Ga.	200	1.65	6	3	2	1	14 62
Rasin's Dixie Guano, manufactured by Rasin Monumental Co., Atlanta, Ga.	200	1.65	6	2	2	2	14 62
Kainit, manufactured by Rasin Monumental Company, Atlanta, Ga.	200	.....	.....	.....	.....	12	12 00
Acid Phosphate, manufactured by Rasin Monumental Company, Atlanta, Ga.	200	.....	10	4	2	.....	14 00
Bone and Potash, manufactured by Rasin Monumental Co., At- lanta, Ga.	200	.....	7	3	2	2	12 00
Dissolved Bone, manufactured by Rasin Monumental Company, Atlanta, Ga.	200	1.65	7	3	2	.....	14 62
Columbia Guano, manufactured by Columbia Fertilizer Co., Co- lumbia, Ala.	200	1.65	6	1	1	2	16 12
Farmer's Friend, manufactured by Columbia Fertilizer Company, Columbia, Ala.	200	1 00	6	1	1	8	15 00
Columbia H. G. Acid Phos. m'd'd by Col. Fert. Co., Columbia, Ala.	200	.....	10	2	1	.....	18 00
Dis. Bone and Potash, m'd'd by Col. Fert. Co., Columbia, Ala.	200	.....	6	2	1	8	18 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Commercial Value.
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1900								
Oct. 1	German Kainit, manufactured by Columbia Fertilizer Co., Columbia, Ala.	200	.....	.....	.....	.....	12	\$ 12 00
..	Sipsey H. G. Acid Phosphate, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	.....	11	2	1	.....	18 00
..	Sipsey H. G. Acid Phos. and Potash, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	.....	9	1	1	2	12 00
..	Graham's Best Guano, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	2	7	2	1	2	16 60
..	Etowah Fertilizer, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	18 80
..	King Cotton, manufactured by Gadsden C. S. Oil Co., Gadsden, Ala.	200	1	9	1	1	1	18 80
..	Our Best Fert. Am. D. B. & Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.80	6.50	2.50	.50	2.00	18 24
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.06	6.50	2.00	.50	1.00	15 06
..	Cotton Queen Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	167	2.00	6.00	1.50	.50	2.00	15 10
..	Waters Special Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.80	.50	1.00	15 00

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Walters Special Dis. Bone and Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	10.00	2.00	1.00	1.00	18.00
Coley's & Sandlin's Spe. D. B. and P., manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	10.00	2.00	1.00	1.00	18.00
Tallapoosa H. G. Acid, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	11.00	2.50	2.00	.....	18.50
Tallapoosa Dis. Bone and Potash, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	10.00	2.00	2.00	1.00	18.00
Our Best Fertilizer D. B. and P., manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	.....	11.00	2.00	1.00	1.00	14.00
Standard Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15.00
Soluble Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	2.00	6.50	2.00	.50	1.00	15.10
Coley & Sandlin's Special Guano, manufactured by Tallapoosa Oil Co., Alexander City, Ala.	200	1.50	7.50	2.30	.50	1.00	15.00
Ober's Sol. Am. Sup. Phos. of Lime, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	.....	6.50	1.50	2	2	15.04
Farmers Standard Am. Phos., manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.70	6.50	1.50	1.50	2	14.78
Ober's Special Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.65	6	3	3	2	15.62
Ober's Dis. Bone with Am. and Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.00	7	2	1.50	2	13.80
Ober's Farmers Mixture, manufactured by G. Ober & Sons Co., Baltimore, Md.	200	.75	7	2	1.50	2	13.10
Ober's Dis. Bone Phos. and Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	.....	8	2	2	2	12.00
Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	.....	6	2	2	4	12.00
Ober's Acid Phos. with Potash, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	.....	8	2	2	4	14.00
Ober's Standard Am. Dis. Bone, manufactured by G. Ober & Sons & Co., Baltimore, Md.	200	1.80	6	2	2	2	15.04

**Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers.**

When Received-	Name of Fertilizer or Chemical, by Whom Manufactured. and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
1900								
Oct. 1	Ober's Dis Bone Phosphate, manufactured by G. Ober & Sons & Co., Baltimore, Md .....	200	.....	11	3	2	.....	\$14 00
..	Randolph Fertilizer, manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	2 00	6 75	1 25	1 25	1 50	15 00
..	Roanoke Guano, manufactured by Campbell & Wright, Jr., Roan- oke, Ala .....	200	1 75	6 75	1 25	1 25	1 00	13 90
..	Pride of Alabama, manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	1 65	6 75	1 25	1 25	2 00	14 62
..	Jones' Best, manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	1 65	6 75	1 25	1 25	1 00	13 62
..	H. G. Cotton Grower, manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	.82	8 50	1 50	1 50	1 00	13 80
..	H. G. English Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	.....	10.	2 00	2 00	.....	12 00
..	Potash Acid Phos., manufactured by Campbell & Wright, Jr., Roanoke, Ala .....	200	.....	8 50	1 50	1 50	2 00	12 00
..	Ashcraft's Formula, manufactured by Tennessee Valley Fert. Co., Florence, Ala .....	200	.....	8 75	1 25	2 76	.....	12 00
..	King Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala .....	200	.82	10 00	.....	2 15	1 00	13 35

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Oct. 1	Florence Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.....	9.67	3.83	1.98	.....	13.00
..	Tiger Guano, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.....	8.75	1.25	2.76	2.00	12.00
..	Corn and Cotton, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	1.85	10.00	.....	.....	1.00	15.62
..	Tiger Acid, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.....	11.88	1.62	2.27	.....	13.00
..	Tiger Cotton Grower, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.83	10.00	.....	.....	1.00	13.80
..	C. S. Meal and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	1.85	10.00	.....	.....	2.00	14.62
..	Blood and Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.82	10.00	.....	.....	1.00	13.80
..	H. G. Dis. Bone, manufactured by Tennessee Valley Fert. Co., Florence, Ala.	200	.....	12.00	.....	.....	.....	12.00
..	S. and K. Am. Diss. Bone, manufactured by Montgomery Fertz Co., Montgomery, Ala.	200	.83	8	2	1	1	13.82
..	Kainit, manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	.....	.....	.....	12	12.00
..	Montgomery Acid Phos. with Potash, manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	8	2	1	2	12.00
..	Meal and Phos. Compound, manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	1.85	7	2	1	.....	13.62
..	High Grade Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	11.	2	1	.....	13.00
..	H. G. English Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	12.	2	1	.....	14.00
..	Star Brand Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	11.	2	1	.....	13.00
..	Early Bird H. G. Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	11.	2	1	.....	13.00
..	S' and K. English Acid Phos., manufactured by Montgomery Fert. Co., Montgomery, Ala.	200	.....	11.	2	1	.....	13.00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	GUARANTEED ANALYSIS					Relative Commercial Value.
			Nitrogen.	PHOSPHORIC ACID.			Potash.	
				Water Soluble.	Citrate Soluble.	Acid Soluble.		
Oct. 13	S. & O. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	18.00
..	Vandiver's XX Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	18.00
..	Griel's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
..	Thompson's English Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	18.00
..	Pinckard's Home Mixture, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
..	Alliance Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	6	2	1	2	14.62
..	Crescent Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	1	14.62
..	Star Brand Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	1	14.62
..	Plow Brand Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.88	8	2	1	1	13.32
..	H. & F. H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00

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W. L. & Co's H. G. Acid Phosphate, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	11	2	1	..	13.00
Dissolved Bone and Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	9	2	1	1	12.00
Alkaline Acid Phosphate 4% Potash, manufactured by Montgomery Fe tilizer Co., Montgomery, Ala.	200	....	6	2	1	4	12.00
English Acid Phosphate with 2% Potash, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	....	10	2	1	2	14.00
S a Gall Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
Capital City Standard Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
Montgomery Blood and Bone Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
Tariff Reform Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
Clayton Fertilizer, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	1.65	7	2	1	2	15.62
Southern Pacific Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Our Cotton Queen Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Early Bird Soluble Guano, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Vandiver's Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Ammoniated Dissolved Bones, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Wilson's Special Compound, manufactured by Montgomery Fertilizer Co., Montgomery, Ala.	200	.83	8	2	1	1	13.32
Schuessler & Co., manufactured by Opelika Chemical Co., Opelika, Ala.	200	....	..	..	..	..	.....
Schuessler H. G. Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	6	2	1	2	14.62



Guaranteed Analyses of Commercial Fertilizers, Filed in the office of the Commissioner of Agriculture by Dealers and Manufacturers.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package	GUARANTEED ANALYSES					Soluble Com- mercial Value.
			Nitrogen.	PHOSPHORIC ACID.				
				Water Soluble.	Nitrate Soluble.	Acid Soluble.	Potash.	
1900								
Oct. 1	Schuessler & Co. Special Formula, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	8	\$ 15 82
"	Schuessler & Co. Beef Blood and Bone, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.83	8	2	1	1	18 82
"	Schuessler & Co. H. G. Bone and Potash, manufactured by Ope- lika Chemical Co., Opelika, Ala.	200	.....	8	2	1	2	12 00
"	Schuessler & Co. H. G. English Acid Phos, manufactured by Ope- lika Chemical Co., Opelika, Ala.	400	.....	10	2	1	.....	12 00
"	Schuessler Bros. H. G. Guano, manufactured by Opelika Chemi- cal Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62
"	Schuessler Bros. H. G. Bone and Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.....	8	2	1	2	12 00
"	Schuessler Bros. XXX Bone and Potash, manufactured by Ope- lika Chemical Co., Opelika, Ala.	200	.....	9	2	1	1	12 00
"	Kainit, manufactured by Opelika Chemical Company, Opelika, Ala.	200	.....	.....	.....	.....	12	12 00
"	C. C. Standard Fertilizer, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	6	2	1	2	14 62
"	Diamond Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62

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Good Luck Soluble Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.88	8	2	1	1	18 83
Standard Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.....	11	2	1	.....	18 00
Opelika Acid Phos. with 2% Potash, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.....	8	2	1	2	12 00
Blood and Bone Guano, manufactured by Opelika Chemical Co., Opelika, Ala.	200	1.65	7	2	1	1	14 62
J. C. Adkin & Son, No. 1 Acid Phos., manufactured by Opelika Chemical Co., Opelika, Ala.	200	.....	11	2	1	.....	18 00
H. G. English Acid Phosphate, manufactured by Opelika Chemical Co., Opelika, Ala.	200	.....	10	2	1	.....	12 00
W. C. Bradley & Co's. Standard Guano, manufactured by Virginia-Carolina Chemical Co., Charleston, S. C.	200	.....	8	2	1	2	12 00
W. C. Bradley & Co's Soluble Guano, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	1.85	6	2	2	2	14 62
W. C. Bradley & Co's H. G. Potash Acid, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	1.65	7	8	2	2	14 62
W. C. Bradley & Co's H. G. Acid Phosphate, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	9	8	2	2	14 00
W. C. Bradley & Co's Standard Pot Acid, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	10	4	2	.....	14 00
T. W. & Co's Eng. H. G. Acid with Mur. Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	7	8	2	2	12 00
T. W. & Co's Bone and Muriate of Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	9	8	1	1	18 00
T. W. & Co's Special H. G. Potash Guano, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	7	8	2	2	12 00
T. W. & Co's Muriate of Potash Mixture, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.82	7	8	2	8	15 80
T. W. & Co's Muriate of Potash, manufactured by Virginia-Carolina Chemical Co., Richmond, Va.	200	.....	9	8	1	2	14 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Continued.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured	Weight of Package.	GUARANTEED ANALYSIS.					Relative Com- mercial Value.	
			Nitrogen.	PHOSPHORIC ACID.					
				Water Soluble.	(Citrate Soluble.	Acid Soluble.	Potash.		
1900									
Oct. 1	Blanchard H. G. Acid Phos. manufactured by Virginia-Carolina Chemical Co., Atlanta, Ga.	200	.....	10	4	2	.....	\$14 00	
"	Rome Soluble Guano, manufactured by Rome Guano Co., Rome, Ga.	200	1.65	6	2	1	2	14 62	
"	Blood and Bone with Potash, manufactured by Rome Guano Co., Rome, Ga.	200	.85	8	2	1	1	18.88	
"	Royal Guano, manufactured by Rome Guano Co., Rome, Ga.	200	1.65	8	2	1	.....	14 62	
"	High Bone and Potash, manufactured by Rome Guano Co., Rome, Go.	200	.....	8	2	1	2	12 00	
"	Standard Acid Phos., manufactured by Rome Guano Co., Rome, Ga.	200	.....	10	2	1	.....	12 00	
"	National Diss. Bone, manufactured by National Fertz. Co., Nash- ville, Tenn.	200	.82	6	4	.....	2	18 29	
"	Blood and Bone Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	.82	6	4	.....	2	18 29	
"	Rock City Guano, manufactured by National Fertz. Co., Nash- ville, Tenn.	200	1.64	5	8	.....	2	14 59	
"	Tennessee Guano, manufactured by National Fertz. Co., Nash- ville, Tenn.	200	1.64	5	8	.....	8	14 59	

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Oct. 1	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	.....	12 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn.	200	10	8	.....	13 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn.	200	10	4	.....	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	10	4	.....	14 00
..	Acid Phosphate, manufactured by National Fertz. Co., Nashville, Tenn.	300	11	4	.....	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	10	4	.....	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	11	4	.....	15 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	12	4	.....	16 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn.	200	6	4	1	11 00
..	Tennessee H. G. Dis. Bone, with Potash, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	2	14 00
..	Sadler's Formula, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	2	14 00
..	Tennessee H. G. Diss. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	.....	12 00
..	Tennessee H. G. Diss. Bone and Potash, manufactured by National Fertz. Co.	200	6	4	2	12 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn.	200	6	4	1	11 00
..	Acid Phos. with Potash, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	2	14 00
..	Tennessee Century Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	8	4	4	16 00
..	Tennessee H. G. Acid Phos., manufactured by National Fertz. Co., Nashville, Tenn.	200	11	4	.....	15 00

Guaranteed Analyses of Commercial Fertilizers, Filed in the Office of the Commissioner of Agriculture by Dealers and Manufacturers—Concluded.

When Received.	Name of Fertilizer or Chemical, by Whom Manufactured, and Where Manufactured.	Weight of Package.	GUARANTEED ANALYSIS.					Relative (Commercial) Value.
			Nitrogen.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Potash.	
1909								
Oct. 1	Old Hickory Guano, manufactured by National Fertz. Co., Nashville, Tenn.	200	1.64	5	8	.....	2	\$14 59
..	Old Hickory Guano, manufactured by National Fertz Co., Nashville, Tenn.	200	1.64	6	4	.....	8	16 59
..	Ammoniated Dias. Bone, manufactured by National Fertz. Co., Nashville, Tenn.	200	.82	6	4	.....	1	18 29
..	Alabama Fertilizer, manufactured by Alabama Fertz Co., Montgomery, Ala.	200	1.80	7	1.50	.....	1.50	15 04
..	Acid Phosphate, manufactured by Alabama Fertz. Co., Montgomery, Ala.	200	.....	11	2	.....	.....	18 00
..	Kainit, manufactured by Alabama Fertz. Co., Montgomery, Ala.	200	.....	.....	.....	.....	12.	12 00
..	Muriate of Potash, manufactured by Alabama Fertz. Co., Montgomery, Ala.	200	.....	.....	.....	.....	52.	52 00
..	Concentrated Tankage, manufactured by Hiller, Hirsch & Co., New York	200	18.	.....	.....	.....	.....	86 40
..	Ground Blood, manufactured by Swift & Co., Chicago	200	14.	.....	.....	.....	.....	42 00

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## LICENSESES.

The following is a list of the Licenses issued this season to July 1st, 1901, with the date when issued, number of license, and post office of the local dealers.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1900.			
Oct. 3	Adair & McCarty Bros.....	Atlanta, Ga.....	4
.. 15	Armour Fertilizer Works.....	Kansas City, Mo..	29
.. 50	Alabama Fertilizer Co.....	Montgomery.....	87
Nov. 19	Adamson & Edwards.....	Ophelia.....	53
Dec. 14	Acree, O. A. C.....	Newton.....	68
.. 27	Adamson, Edwards & Co.....	Ophelia.....	86
.. 29	Allridge & Shelton.....	Brooksville.....	87
.. 31	Allen, C. B.....	Ashland.....	95
1901.			
Jan. 7	Andrews, W. T.....	Gold Hill.....	188
.. 11	Andrews & Co.....	Camp Hill.....	172
.. 12	Alston, S. F.....	Tuscaloosa.....	174
.. 12	Akin, J. C.....	Notasulga.....	178
.. 15	Alston & Farrow.....	Wetumpka.....	184
.. 15	Adkinson, D. I. B.....	Floral.....	189
.. 15	Atkins, V. B. & Co.....	Selma.....	198
.. 15	Akin, J. C.....	Camp Hill.....	206
.. 15	Agee, R. H. & W. C.....	Selma.....	252
.. 15	Ashepoo Fertilizer Co.....	Charleston, S. C.....	285
.. 17	Atkinson & Atkinson.....	Jemison.....	319
.. 17	Atkin & Allgood.....	Thornton.....	341
.. 21	Albritton, E. S.....	Warrior.....	400
.. 21	Ashhurst, J. V.....	Tallassee.....	416
.. 22	Arnold, W. A.....	Ozark.....	424
.. 23	Allen & Co., R. W.....	Lafayette.....	441
.. 23	Atkins, L. C. & Co.....	Langston.....	445
.. 25	Atkins, Jos. M.....	Brompton.....	467
Feb. 1	Adams, J. E.....	Welden.....	512
.. 4	Arant, J. M. & Sons.....	Waverly.....	533
.. 5	Abecrombie, A. J.....	Leeds.....	545
.. 7	Atkins, B. C.....	Reform.....	561
.. 8	Amos, G. H.....	Duck Springs.....	573
.. 13	Agee, W. P.....	Perdue Hill.....	594
.. 19	Allen, L. M. & Co.....	Phil Campbell.....	625
.. 19	Abecrombie, J. H.....	Leeds.....	636
.. 19	Anthony, W. L.....	Hurtsboro.....	637
.. 20	Alh & Crandall.....	Birmingham.....	652
.. 20	Wilderhold, J. L.....	Piedmont.....	656
Mch. 16	Appling Mercantile Co.....	Oakman.....	750
.. 19	Adams, J. G.....	Anniston.....	757

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. Address.	No. of License.
1901.			
Mch. 26	Awbry, J. J.	Mason, Ga.	771
Apl. 4	Atkins & Owens.	Heflin	785
22	Alford, J. C. & Son.	Childersburg.	808
1900			
Oot. 3	Bailey, W. E.	Aster.	11
11	Birmingham Fertilizer Co.	Birmingham	26
Dec. 10	Brantley, T. K. & Ivie	Troy	58
10	Butler, Cole & Co.	New Hope	61
13	Buford & Co.	Hartford	67
22	Bank of Enterprise	Enterprise	81
1901			
Jan. 2	Benson Henderson & Co.	Andalusia.	101
4	Beeland, J. T. & Bro.	Greenville.	114
7	Brice, J. A.	Oneonta	130
7	Brown, J. A.	Kellyton.	136
8	Bates, J. T.	Plevna.	138
8	Butler, F. T. & J. C.	Paint Rock.	146
14	Brannon & Henderson	Troy	199
15	Brown, W. S.	Birmingham	234
15	Bradley Fertilizer Co.	Charleston, S. C.	249
15	Bean & McMurry	Heflin	254
15	Beach, H. M. & Son	Columbia	258
16	Brown, J. W.	Sylacauga.	278
16	Brown, W. D.	Gravella	292
17	Beane Bros	Luverne.	314
17	Barnes, Jasper E.	Dothan.	317
17	Beason, J. L. & Co.	Whitney	320
17	Boon, Alonzo	Camp Hill.	334
17	Bullard, Bartow	Elba	342
17	Barfield Bros	Barfield	343
17	Bell, C. W. & Sons.	Lineville.	344
18	Blackburn, J. W. & McConnel	Fayette	349
18	Butler, C. H.	Childersburg.	351
18	Bullock, J. A.	Shorter	364
19	Bellinger, W. C.	Gadsden	375
19	Bodiford, W. H.	Abbeville.	380
21	Britt & Johnson	Wetumpka.	388
21	Bryan, T. L. & Co	Ozark.	395
21	Bains Bros	Cleveland.	397
21	Burns & Beavers	Lincoln	398
21	Brake, J. L.	Warrior	399
21	Barnett, W. W.	Geneva.	401
23	Beyer, F. & Son	Cullman	444
25	Brantzy, T. M.	Kennedy	465
25	Baird, S. J.	Guin.	468
25	Bynum, W. H.	Boaz.	469
29	Blackwood, D. R.	Cleveland.	488
30	Butler, J. E.	New Hope.	497
30	Brodbeck & Zundel Bros.	Point Clear.	498
31	Boyett Bros & Rodgers	Andalusia.	507

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901.			
Jan. 28	Bear, Lewis & Co.	Pensacola, Fla.	481
.. 28	Brawner & Brawner	Castlebury, Ala.	482
.. 28	Burt, R. A.	Collinsville	483
Feb. 1	Bell, J. J.	Florala	515
.. 2	Banks, T. C.	Attalla	522
.. 2	Burks & Coston	Brantley	526
.. 4	Brundridge Banking Co.	Brundridge	529
.. 4	Bynum, T. D.	Bynum	532
.. 7	Bowdon, C. P.	Gordon	555
.. 7	Boreland, J. B. & Co.	Pinckard	564
.. 11	Burgess, J. L.	Scottsboro	587
.. 13	Blansitt Bros.	Sulphur Springs	596
.. 13	Brown & York	Boaz	606
.. 13	Bell, W. R.	Goddard	614
.. 16	Barton, W. M.	Lynn	623
.. 16	Baite, G. J. & J. W.	Toney	629
.. 19	Black, Jas. A.	Luverne	647
.. 20	Bryant & Williams	Notasulga	658
.. 25	Baccus, W. B. & Son	Baccus	670
Mar. 5	Baker, D. W.	Goodwater	683
.. 5	Boazman, Tom	Marcoot	686
.. 7	Byers, Mrs. Ada V.	Ashville	697
.. 11	Babcock, H. T.	Troy	714
.. 12	Blackburn, N. W. & Co.	Leesburg	738
.. 16	Braswell, M. L.	Pleasant Gap	740
.. 21	Brittain, J. C.	Summit	761
.. 14	Butler & Collier	Gurley	796
.. 26	Banks & Owen	Hurtsboro	806
May 4	Banks, R. D.	Jackson's Gap	809
1900.			
Oct. 3	Continental Fertilizer Co.	Nashville, Tenn.	7
.. 31	Campbell & Wright, Jr.	Roanoke, Ala.	39
Nov. 20	Cowart, J. H. & Co.	Goshen	55
Dec. 10	Cameron, Jas. A.	Columbiana	63
.. 12	Covington, J. I.	Bertha	66
.. 15	Cassels Bros.	Gadsden	70
.. 21	Cross, W. S.	Pelham	78
.. 29	Coley & Sandlin	Alexander City	92
1901.			
Jan. 5	Carlisle, M. W. & Bro.	Roanoke	125
.. 5	Crew, C. M.	Goodwater	126
.. 7	Cox, L. O.	Boaz	127
.. 9	Cullman Cotton Co.	Cullman	149
.. 11	Clark & Parker Bros.	Searight	166
.. 12	Crump, J. C. & Son	Sand Mountain	177
.. 14	Copeland, J. S.	Troy	200
.. 15	Crumpton, W. E.	Maplesville	216
.. 15	Cawthon, W. C. W.	Andalusia	224
.. 15	Carter Co., The J. H.	Cullman	235
.. 15	Cleveland, M. L. & Co.	Randolph	245
.. 15	Cameron Bros.	Notasulga	237



## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901.			
Jan. 15	Carney, W. M. & Co.	Atmore	239
.. 15	Cantelou, Lamar & Son	Wetumpka	262
.. 16	Cross, Fred	Portersville	271
.. 17	Crew, B. F.	Goodwater	322
.. 17	Carter, Jno. S.	Haleyville	333
.. 17	Cole, G. P.	Loachapoka	339
.. 17	Cornelius, H. M.	Walnut Grove	347
.. 19	Carroll, J. S.	Troy	371
.. 19	Chapman & Co.	Geneva	379
.. 21	Crew, J. W.	Elamville	389
.. 21	Campbell & Wright	Tuskegee	391
.. 21	Capps, D. W.	Capps	405
.. 21	Carroll & Watson	Watford	408
.. 23	Cobb, H. C.	Millbrook	431
.. 23	Columbia Fertilizer Co.	Columbia	432
.. 23	Colquitt Bros.	Luverne	434
.. 23	Chadwick & Brice	Snead	435
.. 23	Curry, W. W.	Atbertville	438
.. 23	Carr, J. A.	Carrville	446
.. 28	Collins, N. S.	Collinsville	476
.. 28	Collins, J. R.	Bankston	480
Feb. 1	Chapman & Warren	Georgiana	519
.. 1	Cosper, R. E.	Sterrett	517
.. 4	Collins, H. D.	Fayette	541
.. 8	Coxwell, Jno. M.	Perdue Hill	571
.. 9	Carleton & Co.	Dudleysville	582
.. 13	Clarke & Harwell	LaGrange, Ga.	589
.. 16	Oope, A. M.	Union Springs, Ala.	627
.. 20	Crutchen & Ward	Cuba	654
.. 23	Cox, W. H.	Springville	667
Mch. 5	Collins, The Co.	Warrior	677
.. 5	Costin, J. W. & Co.	Luverne	692
.. 9	Cartwright, R. N.	Cartwright	704
.. 11	Crew, K. A. & Son	Goodwater	717
.. 12	Cooper, J. F.	Fax	729
.. 16	Clem, R. M.	Fairmount	738
.. 16	Coleman & McAlpin	York	744
.. 16	Clements, N. B.	Oregonia	747
.. 30	Crump, H. C.	Sedden	779
April 6	Cothran, T. E.	Alexis	791
.. 22	Crow Bros.	Jacksonville	804
1900.			
Oct. 22	Davenport, N. S.	Valley Head	32
Nov. 12	Dothan Guano Co.	Dothan	48
1901.			
Jan. 4	Dawkins, W. T.	Abbeville	109
.. 8	Dean, J. J.	Charlton	140
.. 10	Davie, B.	Clayton	161
.. 10	Donaldson & Shaw	Haleyville	163

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 14	Dyer, W. C.	Stanton	197
15	Dennis, J. A. & Co.	Ansley	209
15	Dent, Geo. H.	Eufaula	243
15	Dan, J. P.	Milport	246
16	Dumas, O. & C. P.	Arlington	294
16	Davis, W. C. & Co.	Sand Mountain	298
16	Draper & Co.	Oxford	303
17	Dailey, M. W.	Avoca	338
18	Dorman, Jas. F.	Carrville	350
Nov. 21	Davis, E. R.	Rock Run Station	402
21	Darrow, E. J.	Coats Bend	404
23	Duncan, E. P.	Alexander City	440
24	Downey, J. W. & T. B. Chattin	Section	450
Feb. 4	Dyar, C. M. & L. F.	Reedbrake	536
5	Deramus, D. I.	Verbena	546
6	Downs, J. B.	Clanton	551
11	Dann, A. M.	Elamville	588
13	Doughty, J.	Fayette	610
19	Decatur Warehouse & Milling Co.	Decatur	643
25	Davenport, E. T. & Co.	Valley Head	671
Mch. 5	Dunlap, W. R.	Wolf Creek	678
5	Davis, Marshall & Co.	Mobile	695
12	Duncan, R. A.	Dickson	727
16	Davis, Chas. S.	Hurtsboro	743
Apl. 9	Dean, J. I.	Red Level	789
1900			
Oct. 12	Elrod & Gibson	Collinsville	28
Dec. 28	Earle, Terrell & Co.	Birmingham	38
1901			
Jan. 15	Emmett, L. S., Son & Co.	Albertville	253
16	Edmonson, R. Q. & Bro.	Eufaula	281
18	Espy, Jno. R.	Gordon	355
22	Ellis, J. M. & Son	Union Springs	430
26	Evens Bro's	Heflin	473
Feb. 1	Echols & Hargrove	Hartselle	519
5	Ellison, W. L.	Walnut Grove	543
7	Edwards, J. B.	Talladega	554
19	Eubanks & Cheney	Piedmont	642
20	Edwards, R. D.	Sylacauga	650
Mch. 16	Elliott, J. A. & Son	Moundville	746
16	Evens, D. H.	Hillion's Store	749
May 17	Elington, S. M.	Munford	815
1900			
Oct. 3	Furman Farm Improvement Co.	Atlanta & E't Pt., Ga	5
Nov. 15	Farmers & Merchants Bank	Troy	50
Dec. 14	Foy, Cliff & Bro's	Abbeville	69
20	First Bank of Elba	Elba	76
1901			
Jan. 4	Folmar, W. B.	Troy	111
4	Frazen & Olson	Thorsby	112

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of
<b>1901</b>			
Jan. 4	Flynt, H. L.	Guntersville	11
5	Folmer, Walden & Byrd	Enterprise	12
10	Farley, Jno. C.	Opelika	18
14	Farmers Alliance Co-operative Co.	Opelika	19
14	Farrow, T. L.	Guntersville	20
15	Fuller, Foshee Mercantile Co.	Brewton	22
15	Fuller, J. H. & Sons	Alexander City	25
19	Farnham, J. H.	Evergreen	30
22	Fleming, W. L. & Son	Brundidge	42
28	Forrester, R. B.	Cowarts	43
30	Fountain, H. B.	Albertsville	54
Feb. 4	French, J. E.	Brundidge	52
19	Flippo & Phillips	Bear Creek	64
23	Farrell, J. D.	China Grove	65
Mch. 5	Fort Gaines Oil and Guano Co.	Fort Gaines, Ga.	67
12	Foust, V.	Rosa	72
13	Feagin, T. K.	Feagin	73
16	Fruitdale Lumber Co.	Fruitdale	74
19	Frames, J. H.	Slate	75
26	Farrin, A. J.	Ohatchee	75
28	Felder, J. B.	Loachapoka	77
28	Fields, A. S.	Fern Bank	77
<b>1900</b>			
Oct. 3	Goulding Fertilizer Co.	Pensacola, Fla.	1
6	Georgia Chemical Works	Augusta, Ga.	2
8	Grisham, J. M.	Whitehead	2
Dec. 10	Gadsden Installment House	Gadsden	5
19	Gadsden Cotton Seed Oil Co.	Gadsden	7
<b>1901</b>			
Jan. 3	Gulledge, F. A.	Verbena	10
3	Goldthwaite, Robt.	Montgomery	10
14	Guthrie Bros	Sulligent	17
15	Gary, Kennedy & Co.	Selma	22
15	Griel Bro's & Co.	Montgomery	24
15	Guin Bro's	Kennedy	24
16	Gilbert, R. F.	Portersville	27
16	Grady, J. W.	Stroud	28
16	Guntersville Dry Goods Co., The	Guntersville	30
16	Grant Bro's	Louisville	30
17	Gilliland, C. H. & Sons	Goodwater	32
17	Gray, J. B. & W. W. Gulledge	Ohatchie	33
19	Gunter, G. W.	Brockton	38
21	Gunter & Ealun	Gantt	40
24	Green, Jas. F.	Arthur	45
28	Green, Alex.	Thomasville	48
30	Green & Mullins	Active	49
Feb. 2	Gallant, J. A.	Gallant	52
4	Glenn Bro's	Branchville	53
7	Golden, B. F.	Thaddeus	55
13	Graham, J. R.	Boliver	56

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901.			
Feb. 13	Gage, W. A. & Co.	Town Creek	592
.. 18	Graves & Burdine	Deposit	598
.. 18	Grace, J. W.	Elkmont	611
.. 14	Gilbert, J. J. & Sons	Gold Mine	615
.. 16	Gilbert, John R.	Pinckneyville	630
.. 22	Gilliland, M. E.	Hill	659
.. 22	Griffith, Asa	Hanceville	660
Mch. 5	Griffs & Son	Sedden	676
.. 5	Gray, Wm	Dadeville	685
.. 9	Griffith, G. F.	Hokes Bluff	705
.. 12	Guin, P. C.	Covin	731
.. 12	Gable & Clapp	Gum Springs	732
.. 19	Gilbert, P. N.	Coalville	755
.. 30	Gammill, J. W.	Camp Hill	775
Apl. 23	Gooday Bros.	Daphne	799
May 4	Goldson Harper & Son	Brocton	808
.. 4	Gray, W. C. & Co.	Oxford	811
1900.			
Oct. 8	Home Mixture Guano Co.	Columbus, Ga.	9
.. 11	Helm Bone Fertilizer Co.	Birmingham	25
.. 38	Howe & Co.	Stevenson	34
.. 31	Holman, H. C.	Ozark	40
Nov. 15	Henderson, Fox	Troy	51
Dec. 10	Ham, P. J. & Sons	Elba	60
.. 19	Henderson, Rainer & Hill	Brantley	75
.. 21	Howell, J. R. G.	Dotman	77
.. 22	Henderson, Holloway & Co.	Enterprise	82
.. 31	Hester, R. B. & Son	Roanoke	93
.. 31	Holly & Lindsay	Abbeville	94
1901.			
Jan. 1	Henderson, J. D. & Co.	Searight	99
.. 2	Hill, Jones & Co.	Roanoke	102
.. 3	Hill & Shaffey	Dadeville	106
.. 4	Hilton, Bentley & Cosby	Brantley	113
.. 4	Hatton, D. J. & Son	Wait	115
.. 4	Howard, J. M.	Albertville	168
.. 4	Howle, T. A. & Co.	Oxford	173
.. 14	Herring, T. J.	Midland City	194
.. 16	Hilliard, W. L.	Troy	198
.. 14	Henderson, J. Robt	Fullerton	205
.. 15	Henderson & Waters Bros.	Brundridge	218
.. 15	Howle Bros.	Wetumpka	230
.. 15	Hertzler & Anderson	Madison	231
.. 15	Howison, Allen P.	Randolph	266
.. 16	Henderson, Chas.	Troy	269
.. 16	Henry, S. W.	Springville	272
.. 16	Harrison, W. D. & Co.	Ashford	295
.. 16	Henderson, J. H.	Cross Keys	300
.. 16	Hartsell, J. C. & Son	Hartselle	310
.. 17	Hooper, C. W. & Co.	Selma	323

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 17	Hughes & Bros	Flolala	829
18	Harwell, W. O.	Opelika	354
19	Hixon, S. D. & D. A.	Perote	387
21	Head, T. L.	China Grove	408
21	Hughes, D. D.	Labanon	414
21	Hooper, A. B.	Alexander City	415
22	Haralson, J. B.	Langston	416
22	Haynes, D. P. & Bro.	Oxford	428
23	Hartsell, J. P.	Hartselle	442
23	Hoffman & Graves	Waverly	448
23	Hixon Bros	Hixon	447
24	Hayes, Parker & Co.	Lineville	448
24	Haight, J. H. & Son.	Fruitdale	453
24	Hicks, W. W. & Co.	Dadeville	455
25	Harrell, W. F.	Bangor	460
29	Hodo, J. B.	Millport	489
30	Hammond, M. W.	Marl.	498
30	Hood, J. M. & Son.	Albertaville	501
31	Heard & Lee	Camp Hill	506
Feb. 1	Hamilton, M. D. & Co.	Guin	514
1	Herrin & Oliver	Dadeville	581
4	Head & Warren	Gum Springs	547
6	Hicks & Heard	Camp Hill	548
6	Hudges, J. A.	Ashville	570
6	Hightower, C. B.	York Station	578
6	Haley Bros	Hayleyville	579
6	Hamilton, N. O.	Ragland	581
6	Hood, Yielding & Co.	Birmingham	584
6	Hood, Robt.	Kymulga	602
6	Henderson & Black	Troy	604
6	Henderson, Alex. & Co.	Troy	605
6	Hamilton, R. F.	Coal City	617
6	Herston & Barnes	Garland	673
6	Hitchcock, J. G. & Son	James	690
6	Hearn & Wood	York	700
Mch. 8	Harris & Sherrod	Courtland	708
8	Harkins, Max & Clyde	Fayette	718
11	Hudson, F. N.	Blountsville	741
16	Hargrove, J. H.	Hartselle	760
21	Hendrix, S. T.	Peterman	782
30	Hodges Mercantile Co.	Ashville	780
Apl. 5	Hollinsworth & Co.	Millin	787
10	Haynie, A. C.	Hurtsboro	792
22	Hicks & Son	Standing Rock	800
25	Hall, J. A.	Pea Ridge	805
Dec 6	Heggen & Co.	Anniston	64
Jan. 1	Ivey, J. W.	Rutledge	211
Feb. 4	Ivey, C. & Frawick	Opelika	537
19	Ivey, C.	Evergreen	638

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1900			
Oct. 23	Jones, J. B.	Fayette	85
Dec. 29	Johnston, Geo. A.	Clayton	91
1901			
Jan. 15	Jones, V. D.	Troy	238
.. 15	Johnson, W. A.	Rutledge	256
.. 18	Johnston, Thos. L. & Co.	Gadsden	359
.. 21	Jennings, B.	Tuskegee	390
.. 21	Jordan, H. R. & Son	Collinsville	392
.. 22	Jackson, Jess H.	Grand Bay	420
Feb. 1	Jemison, S. E.	Sunny Side	511
.. 2	Johnson, L. M.	Alexander City	523
.. 8	Johnson, J. J.	Geneva	577
.. 13	Jackson, Geo. W.	Mount Hope	591
Mch. 5	Johnson, J. E.	Chattanooga, Tenn.	694
Apl. 5	Jones, A. F.	Talladega	786
1900			
Oct. 18	Killian, H. H.	Branden	80
1901			
Jan. 11	King, H. S.	Searight	167
.. 11	Kelly & Segrist	Midland City	169
.. 16	Kyser, Geo. W.	Ripton	277
.. 16	Kroell, Geo.	Montevallo	279
.. 16	King, F. R. & Co.	Leighton	812
.. 19	King, Claude	Leighton	386
.. 21	Klaus, J. & Co.	Huntsville	413
.. 22	Kitchens, J. W. & Bro	Heflin	421
.. 24	Kelly, D. E. & J. O.	Jeff	457
.. 28	Kelly, Walter	Normal	497
.. 28	Killen Dry Goods Co., The.	Fort Payne	484
Feb. 6	Kennedy, J. A.	Loop	552
Mch. 9	Kinney, P. H. & Co.	Navvoo	705
Apl. 5	Keener, D. P.	Keener	784
1900			
Oct. 3	Louisville Fertilizer Co.	Louisville, Ky	14
Dec. 11	Long Bro's	Jasper	65
.. 21	Long-Richardson Mercantile Co	Jasper	80
1901			
Jan. 2	Law, Edmons & Byrd	Enterprise	97
.. 5	Lester & Co	Columbiana	123
.. 7	Leach, R. R.	Liberty	135
.. 8	Land, J. G.	Cullman	145
.. 9	Loeb, J. & Bro.	Montgomery	147
.. 12	Lauderdale, A. R.	Goodwater	175
.. 14	Lull & Lacy	Wetumpka	202
.. 15	Lazinby, Reynolds & Co.	Forest Home	212
.. 15	Langston, J. N.	Jemison	217
.. 15	Little, Chas. E.	Auburn	247
.. 15	Law & Davis	Lincoln	261
.. 16	Lidden, F. B. & Co.	Gordon	284
.. 16	Lane Bro's	Sylacauga	291

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 18	Leath, Scott	Cullman	357
18	Leeman, E. D.	Athens	365
19	Landers Bro's	Heflin	383
23	Long, T.	Greenville	433
28	Latham, S. A. & Co	Montevallo	478
29	Livingston, Y. C.	Notasulga	487
30	Long, C. W.	Tranger	495
Feb. 7	Lowery, W. W. & Co	Atmore	533
7	Long, W. R.	Lynn	545
18	Legg, Joel W.	Elkmont	595
18	Lagney, H. W.	Eden	607
18	Linn, W. W.	Falkville	612
18	Logan, W. J. P.	Benson	618
16	Laxon & McCord	New Market	621
19	Landham, J. R. & Co	Anniston	632
22	Lewis & Estes	Athens	661
Mch. 9	Lile, J. L.	Trinity	707
18	Lumpkins, J. B. H.	Jacksonville	755
30	Lowe, A. S.	Hazel Green	781
Apl. 10	Lyon, R. L.	Riley	794
10	Lee, W. A.	Glen Allen	795
26	Lefils, W. F. & Son	Easonville	807
May 28	Lloyd, Ellison & Co	Creek Stand	812
1900			
Oct. 8	Marietta Guano Co	Atlanta, Ga.	2
8	Mobile Phosphate Co	Mobile	10
8	Meridian Fertilizer Factory	Meridian	13
8	Montgomery Fertilizer Co.	Montgomery	19
30	Marks & Gayle	Montgomery	36
Nov. 12	Malone & Sons	Dothan	47
Dec. 19	Meadows, Smith T. & Co	Opelika	73
31	Mullins, W. I.	Clanton	96
1901			
Jan. 8	Manley, Hornsby & Handley	Roanoke	107
7	Mills, J. B.	Abbeville	129
7	Milner, Henry	Columbiana	131
8	Moon & Harris	Lineville	139
14	Macon, W. H.	Wetumpka	183
14	Masterson, T. C.	Arcola	204
15	Moody, J. W. & Son	Brompton	233
15	Middlebrook, J. Z.	Elamville	250
16	Maxwell, C. R.	Northport	287
16	Metcalf, P. M.	Hartford	296
16	Miller, Lovelace & Co	Dadeville	306
17	Mizell & Bro	Ozark	316
17	Mayo, A. B.	Talladega	329
17	Milligan, W. G.	Heflin	345
17	Mahan, W. H. & Son	Randolph	348
19	Murphree, Joel D.	Troy	370
19	Murphree, J. D. Jr., Cashier	Troy	379

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of Licenses.
1901			
Jan. 21	Myers, H. J.	Langston	398
.. 30	Moog & Weil	Battles	500
Feb'y. 4	Murdock, E. H. & A. S.	Coffee Springs	542
.. 7	Moore, Chancey & Pepper	Phil Campbell	559
.. 16	Mays & Winter	Waverly	625
.. 23	Merritt & Adams	Geneva	666
Mch. 5	Melton & Co.	Pine Apple	682
.. 5	Mills, W. R. & Sons	Pine Apple	688
.. 7	Maroney, C. L. & Co.	Montevallo	696
.. 9	Miller & Sons	Oxford	708
.. 11	Mathews, J. E.	Flint	715
.. 16	Moore, S.	Courtland	753
Feb. 7	Mayberry, W. C. & Sons	Waverly	562
.. 8	Moore, W. S.	Perdue Hill	572
.. 8	Montgomery Bros.	Lincoln	575
.. 8	Miller & Barnett	Berry	578
.. 13	Mapes, M. A.	Phil Campbell	600
Jan. 4	McClung, F. M.	Coats Bend	120
.. 8	McEntine & Millard	Hanceville	144
.. 9	McNaro & Pitman	Albertville	148
.. 14	McKenzie, W. F.	Greenville	198
.. 15	McGehee, Driver & Co.	LaFayette	227
.. 15	McEntyre, Henderson & Adams	Ozark	240
.. 16	McGowen, W. E.	Cuba	302
.. 18	McDonald, T. C.	Luverne	305
.. 17	McClusky & Co. and Boaz Gin Mill Co.	Boaz	346
.. 22	McMillan & Harrison	Mobile	413
.. 25	McEntire Bros.	Cullman	468
Feb'y. 4	McCallet, James E.	Deposit	535
.. 4	McCluney & Miller	Coats Bend	538
.. 7	Mackentepe, J. W. & Son	Cullman	569
.. 16	McWorter, A. J.	Stricklin	624
.. 20	McIntyre & Sellers	Ashford	655
Mch. 5	McEntyre, T. H. & Co.	Coffee Springs	679
.. 7	McCrackin & Baker	Berry Station	698
.. 23	McQueen, J. S. & Co.	Greenville	773
1900			
Oct. 3	N. O. Acid and Fertilizer Company	New Orleans, La.	16
Nov. 3	Navassa Guano Co.	Wilmington, N. C.	43
Dec. 24	National Fertilizer Co.	Nashville, Tenn.	84
1901			
Jan. 8	Newman, Robert	Abbeville	108
May 15	Neighbors, J. A. & Co.	Goodwater	264
.. 9	Neighbors, T. L. & Bros.	Goodwater	152
.. 15	Newton, W. F.	Dothan	221
.. 16	Nichols, J. A.	Childersburg	286
.. 21	Nation & Pate	Liberty	407
Jan. 21	Noble, M.	Avery	408
.. 29	Northcutt, J. A.	Winfield	491
Feb'y. 1	Newton, W. M.	Bellville	513



## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of Licenses.
1901.			
Feb'y. 7	Nolan Bros .....	Alexander City .....	556
16	Nelson, Mrs. A. B. ....	Walnut Grove .....	622
16	Nixon, W. D. ....	Merrellton. ....	628
20	Neher, E. J. ....	Holleywood .....	648
Mch. 12	Nettles, T. A. ....	Kempville .....	725
15	Nicholson, L. S. ....	Collinsville. ....	738
25	Norwood & Co. ....	Ft. Deposit. ....	765
30	Nix, Thomas. ....	Travis .....	778
1900			
Oct. 3	Old Dominion Guano Co. ....	Atlanta, Ga. ....	15
3	Opelika Chemical Co. ....	Opelika .....	20
30	Ozark C. S. Oil Mill Fert. Co. ....	Ozark .....	38
1901			
Jan. 14	Ober, G. & Sons Co. ....	Baltimore, Md. ....	185
16	Oakley, W. F. ....	Columbia .....	290
17	Ogletree, T. W. ....	Eastaboga. ....	327
18	Overton, E. A. ....	Huntsville. ....	358
19	Ogden, F. & Sons. ....	Sulligent. ....	381
Jan. 2	Oldfield, John M. ....	Hazel Green. ....	410
Feb. 14	Oliver, J. M. ....	Oadeville. ....	618
Mch. 11	Overstreet, W. W. ....	Greensboro. ....	719
1900			
Nov. 2	Patrick, P. A. ....	Florence. ....	41
Dec. 29	Perryman, Bros. ....	Heflin. ....	90
1901			
May 2	Presswood, J. A. ....	Andalusia. ....	100
4	Pilcher, Geo. W. ....	Dothan. ....	110
5	Pinkard, E. M. ....	Clanton. ....	124
9	Pittman, A. J. ....	Wehadkee. ....	150
9	Pilcher, W. C. ....	Dothan. ....	154
10	Patton & Archibald. ....	Foster. ....	158
11	Phillips, J. R. & Co. ....	Bear Creek. ....	170
14	Pridley, W. G. ....	Sulligent. ....	180
14	Pinkston, J. C. ....	Shorter. ....	195
15	Planters and Merchants Bank. ....	Ozark .....	220
15	Platt and Long. ....	Kennedy. ....	244
15	Phillips Bros. ....	Oxford. ....	260
15	Pacific Guano Co. ....	Charleston, S. C. ....	266
15	Patapasco Guano Co. ....	Baltimore, Md. ....	267
Jan. 16	Parish, T. R. & Bros. ....	Clayton. ....	275
16	Pope, J. F. & Co. ....	Vincet. ....	289
16	Parker, James M. ....	Equality. ....	297
16	Pearce, J. P. Son & Co. ....	Carbon Hill. ....	309
16	Pearson, H. W. ....	Alexander City. ....	311
17	Planters Warehouse and Commission Co. ....	Eutaw. ....	326
18	Patterson, M. F. & Son. ....	Falkville. ....	356
18	Pope, G. W. & Co. ....	Luverne. ....	367
19	Perkins, Jr., W. W. Estale. ....	Springville. ....	378
21	Phillips & Goddard. ....	Clarence. ....	393
21	Porter & Foster. ....	Town Creek. ....	412

## LICENSEES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 25	Porter, O. J. & Co.	Jacksonville.	484
.. 26	Perry, W. O.	Seale.	471
.. 26	Pearce, Jim & Co.	Guin.	475
.. 30	Pierce, W. S. & Co.	Louisville.	508
.. 31	Pope, J. F.	Wilsonville.	504
.. 31	Pearce, J. M.	Pearce's Mill.	508
Feb. 1	Prattville Mercantile Co.	Prattville.	521
.. 8	Pride, W. G. & Bro.	Madison.	568
.. 9	Pope, M. F.	Fayetteville.	580
.. 8	Payne, J. M.	New Market.	587
.. 8	Probst Bros.	Fayette.	608
.. 16	Patterson, J. B.	Mid.	628
.. 16	Pressly & Co.	Springville.	631
.. 26	Peacock, S. D.	Garland.	672
Feb. 5	Pilley, R. L.	Georgiana.	681
.. 5	Patterson Bros.	Pine Apple.	687
.. 5	Porter & Stewart.	Munford.	689
.. 8	Pridgen, J. M.	Key.	702
.. 9	Pruett & Pruett.	Goodwater.	711
.. 12	Pully, C. H. & Co.	Huntsville.	728
.. 16	Pitts, W. M.	Union Springs.	742
.. 26	Phillips, J. P. & Co.	Ashville.	766
Apr. 17	Penny, M. F.	Hoke's Bluff.	797
May 7	Parker, C. C. & Co.	Albertville.	810
.. 18	Pepper, W. J.	Phil Campbell.	814
1900			
Oct. 22	Read Phosphate Co.	Nashville, Tenn.	83
Nov. 8	Rasin-Monumental Co.	Baltimore, Md.	44
Dec. 8	Rome Guano Co.	Rome, Ga.	57
1901			
Jan. 2	Rainer Bros.	Troy.	96
.. 4	Rogers, J. W.	Burleson.	116
.. 7	Rhodes & Bro.	Georgiana.	126
.. 7	Riddle, A. J. & Son.	Arab.	184
.. 7	Rouse, L. D.	Wetumpka.	187
.. 9	Reynolds, H. C. & W. B.	Centreville.	151
.. 9	Robertson & Floyd.	Opelika.	153
.. 10	Rice & Russell.	Arab.	164
.. 14	Riddle, D. H.	Goodwater.	181
.. 15	Riddle, S. W. & Co.	Gadsden.	215
.. 16	Rhodes Mill & Mercantile Co., The N. M.	Shell.	299
.. 17	Ramage, Jas. T.	Brundidge.	335
.. 18	Reynolds Bros.	Jamison.	361
.. 19	Russell, R. A. & Co.	Gaylesville.	373
.. 19	Reaves, Launders & Co.	Defin.	384
.. 21	Russell Bros.	Attalla.	394
.. 22	Rainer, S. P.	Union Springs.	429
.. 24	Roe, S. N.	Elba.	452
.. 24	Reynolds, E. H.	Notasulga.	458
.. 25	Riley, F. M.	Riley.	463

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 28	Read & Co.	Edwardsville.	473
.. 29	Reynolds, J. F.	Nottingham	490
.. 30	Rigsby & Camp	Phil Campbell.	494
.. 30	Randall & Son	Daphne	499
Feb. 1	Robertson, Robt. C.	Fayette	510
.. 1	Ryan & Co	McGuinn.	518
.. 18	Rentz & Turner	Thomasville	598
.. 19	Robertson, Jas. R. & Son.	Cropwell	683
.. 19	Roberts, G. W.	Collinsville	645
.. 20	Russell, W. W.	Fort Payne	649
.. 28	Ranschenburg, C. F.	Spruce Pine	664
Mch. 8	Rodgers, T S.	Morris	701
.. 9	Rice, C. E.	North Port.	713
.. 11	Reynolds, H. C & W. B.	Blotson	716
.. 11	Reynolds, Walker.	Rendalia	724
.. 12	Roberts, J. E.	Pleasant Gap.	739
.. 16	Rosser & Johnson	Dadeville	745
.. 21	Roberts, W. I.	Fayette	759
.. 22	Roy, J. D.	Deatsville	763
.. 26	Kobbins & McGowan Co.	Brewton	767
1900			
Oct. 3	Stumpe, J. M.	Florence	1
.. 8	Swift Fertilizer Works	Atlanta, Ga.	12
.. 8	Standard Guano & Chemical Mfg. Co.	New Orleans, La.	17
Dec. 10	Smith, R. H.	Collinsville.	62
.. 15	Stewart, W. A.	Dawson.	71
.. 17	Savannah Guano Co.	Savannah, Ga.	72
.. 21	Sanders, J. G. & John.	Dothan.	79
.. 22	Stokes, R. E.	Abbeville	83
.. 28	Snead, J. H.	Boaz	89
1901			
Jan. 3	Snead, Jas. E.	Snead	105
.. 4	Sellers & Orum	Montgomery	119
.. 7	Schuessler & Co.	Roanoke	132
.. 8	Stiefelmeyer, C. A.	Cullman	142
.. 10	Snead, C. E. & Bro.	Boaz	160
.. 14	Smitherman, H. M.	Goodwater.	162
.. 14	Smith Bros. & Co.	Warrenten	186
.. 14	Stiefelmeyer, C. A.	Hanceville.	187
.. 14	Stewart, S. E.	Hartselle	188
.. 15	Stephens, S. B.	Petrey	208
.. 15	Schloss & Kahn	Montgomery	210
.. 15	Sellers, W. R.	Troy	223
.. 15	Savage, Chas. B.	Evergreen	226
.. 15	Sturkie & Duke	Gadsden	229
.. 15	Shepherd, Z.	Georgiana	242
.. 15	Sanders, G. A. & Son	Luverne	257
.. 16	Stewart, T. F.	Spring Garden	288
.. 16	Schiffman, S. & Co.	Huntsville	301
.. 16	Sibert, W. J.	Gadsden	308

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901			
Jan. 16	Scholze & Bro. ....	Chattanooga, Tenn.	812
17	Simms & Bro. ....	Blountsville, Ala.	815
17	Spraggins, J. R. ....	Hackleburg, ....	818
17	Shorter, E. S. & Co. ....	Eufaula.	824
17	Shipp & Co. ....	Albertville	828
17	Stanley Bros.	Jasper.	831
17	Scarborough, W. A. & Co. ....	White Plains	832
17	Shellmet N. S. ....	Welsh	840
18	Storey, The A. G. Mercantile Co. ....	Talladega	853
18	Snodgrass, J. D. ....	Scottsboro	860
18	Sanders & Son. ....	Columbia	862
19	Smith, J. W. ....	Cooper	877
19	Smith, M. S. ....	Selma	885
22	Smith & Davis	Fort Payne	426
23	Schuessler Bros.	LaFayette	436
23	Selman & Co. ....	Albertville	437
24	Gelf, E. ....	Selfville	454
24	Smith, G. H. ....	Ealums	456
25	Sellers, C. W. & Sons	Inverness	459
26	Stark, W. E. ....	Seale	470
26	Stokes, Sessions & Co.	Ozark.	485
Feb. 1	Sessions & Mizell. ....	Enterprise	516
4	Strock, W. H. ....	Verbena	527
5	Stephens, T. H. & H. B.	Seaborn	544
6	Stonacher, F. W. ....	Luttrell	549
7	Schwab Jonas Co. ....	Birmingham	550
8	Smith, E. S. ....	Argo	552
7	Stringfellow, E. M. ....	Reform	560
8	Shreve Bros.	Andalusia	567
13	Smith, Fred.	Steels Depot.	601
19	Smith, M. L. ....	Dadeville	634
19	Shaw, W. A. ....	Winfield.	641
19	Sellman, A. J. ....	Albertville	644
22	Stewart, Formby & Co. ....	Piedmont.	657
22	Sampy, W. L. ....	Gadsden.	658
22	Sims, J. F. ....	Brompton	662
22	Stewart & Hazlewood.	Eden.	663
24	Stanford & Collins.	Crews Depot.	665
Mch. 12	Sellers, R. D. & Son	Omega	728
12	Smith, H. B. ....	Yancey	730
14	Searight Mercantile Co.	Searight.	735
30	Smith Bros.	Sylacauga	776
30	Stewart, T. O. ....	Munford	777
Apr. 2	Scott, G. G. ....	Mt. Pleasant.	782
5	Stewart, B. M. & J. E.	Spring Garden	788
6	Stone, J. A. ....	Alexis.	790
Feb. 17	Skelton, R. S. ....	Scottsboro	798
May 8	Snow, P. H. & J. T. Mosely.	Boaz	813
1900			
Oct. 5	Tennessee Chemical Co. ....	Nashville, Tenn.	6

## LICENSES—Continued.

Date of Issue.	AME.	P. O. Address.
1900		
Oct. 5	Troy Fertilizer Co.	Troy
.. 18	Pallapoosa Oil Co.	Alexander City
.. 8	Thompson & Kelley	Normal
Nov. 2	Tennessee Valley Fertilizer Co.	Florence
.. 5	Trawick & Jernigan	Opelika
.. 14	Talladega Fertilizer Co.	Talladega
Dec. 24	Tuscaloosa Cotton Seed Oil Co.	Tuscaloosa
1901		
Jan. 10	Thomas Bros.	Alexander City
.. 11	Tucker, Willingham & Co.	Lafayette
.. 14	Talley, J. T.	Roanoke
.. 14	Thornton, E. L., Manager	Mountain Creek
.. 15	Thornton, B. E.	Gordo
.. 15	Turnipseed, W. O.	Oxford
.. 16	Truss, Geo. M. & Co.	Springville
.. 18	Thomas, W. C. & Co.	Gold Hill
.. 19	Teague, S. F.	Birmingham
.. 25	Thomasville Mercantile Co.	Thomasville
.. 26	Thompson, W. C.	Hartselle
Feb. 1	Thompson, W. C. & Co.	Prattville
.. 4	Talley, Dyer N.	Trussville
.. 7	Towers, W. W.	Maple Grove
.. 8	Thompson, C. W.	Tuskegee
.. 18	Tisdale, W. R.	Andalusia
.. 14	Tabor, Jno. T. & Co.	Keener
.. 19	Teague Bros.	Ashville
.. 20	Thomas & Barwick	Oneonta
Mch. 5	Terry, A. T. & Son	Forney
.. 11	Taylor, G. W.	Huckabee
.. 26	Toney, Harris	Swancott
.. 26	Trammell & Co.	Roanoke
1900		
Nov. 26	Union Fertilizer Co.	Atlanta, Ga.
1901		
Feb. 13	Usry, O. E.	Hebron, Ala.
1900		
Oct. 8	Virginia and Carolina Chemical Co.	Atlanta, Ga.
.. 11	Virginia and Carolina Chemical Co.	Newnan, Ga.
Nov. 5	Vandiver & Co., W. F.	Montgomery
1901		
Jan. 15	Vandegrift, A. B. & Son	Birmingham
.. 16	Virginia and Carolina Chemical Co.	Charleston, S. C.
.. 16	Vaughn, W. B.	Elkmont
.. 16	Vinson Banking Co.	Georgiana
1900		
Oct. 8	Winston, J. H.	Jenifer
Nov. 16	Winkler, A. G.	Greenville
.. 19	West & McMurry	Roanoke
1901		
Jan. 4	Wright, Henderson & Co.	Elba

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.	No. of License.
1901.			
Jan. 5	White & Awbrey .....	Roanoke' .....	122
8	Wood, N. W. ....	Collinsville .....	141
8	Wood, W. J. ....	Abbeville .....	148
8	Williams, T. B. ....	Cullman .....	155
10	Wilhite, W. B. ....	Hartselle .....	156
10	Webb, Jno. C. ....	Demopolis .....	159
11	Walker, Rushton & Co. ....	Rutledge .....	166
21	Walker, J. E. ....	Alexander City .....	176
24	Weathers, Swann & Co. ....	Roanoke, .....	207
15	Warten, Henry .....	Athens .....	213
15	White & Edmonson .....	Troy .....	219
15	Woodward, J. B. ....	Talladega .....	232
15	Wilder, R. M. ....	Brantley .....	248
15	Ward, W. L. & Son .....	Selma .....	263
16	Windham, W. C. ....	Troy .....	268
16	Warnock & Sons .....	Oxford .....	276
16	Whaley, Monroe .....	Blountsville .....	283
16	Wolf, John P. ....	Piedmont .....	285
17	Wright, A. R. ....	Farill .....	321
17	White, J. B. & Co. ....	Talladega .....	330
17	White & Spigener .....	Goodwater .....	352
18	Weil, M. W. & Co. ....	Huntsville .....	366
19	Walker & Ashcraft .....	Kennedy .....	424
21	Willis, J. J. S. ....	Mt. Andrew .....	411
22	Webb & Morgan .....	Langston .....	417
22	Whitehead, J. B. ....	Winfield .....	422
22	Watkins, F. ....	Opelika .....	423
22	White, M. A. ....	Attalla .....	427
23	Westmoreland, J. E. F. ....	Florence .....	479
29	Walker, J. H. ....	Wolf Creek .....	492
31	Williams, P. ....	Lebanon .....	506
Feb. 2	Welch, R. G. & Co. ....	Wilsonville .....	524
4	Wilder, A. C. & Co. ....	Vincent .....	530
4	Welch & Co., Wm. ....	Alexander City .....	540
8	Winn & Son .....	Clayton .....	574
9	Waite & Maddox .....	Easonville .....	583
9	Wood, R. R. ....	Childersburg .....	585
9	Wise, G. W. ....	Madison .....	586
13	Wilson & Co. ....	Russelville .....	609
14	Walker, F. M. ....	Dadeville .....	616
14	Williamson, F. F. & Son .....	Opelika .....	620
19	Walls, H. D. ....	Grant .....	639
23	Woodall, A. W. ....	Springville .....	668
28	Wood & Hattermer .....	Fort Deposit .....	674
Mar. 5	Ward, H. B. ....	Cuba .....	680
5	Windham & Ennis .....	Hillsboro .....	693
7	Wallace, S. H. ....	Klein .....	699
9	Williams, Pinkney .....	Lebanon .....	706
9	Walkley, D. W. ....	Wetumpka .....	712

## LICENSES—Continued.

Date of Issue.	NAME.	P. O. ADDRESS.
1901.		
Mch. 11	Wilson, W. M. & Bro.....	Clanton.....
.. 11	Walker, J. T. & J. B.....	Plevna.....
.. 11	Wilson, J. C. & Son.....	Lincoln.....
.. 11	Williams, J. S.....	Pansey.....
.. 11	Winter, Loeb & Co.....	Montgomery.....
.. 11	Waldrip, J. R.....	Hanover.....
.. 11	White, J. W. Bros.....	Clayton.....
.. 11	Windham & Co.....	Moulton.....
.. 11	Wedgeworth, Walter E.....	Akron.....
.. 11	Wedgeworth, Will M.....	Greenwood.....

## FERTILIZER LAWS.

### PROVISIONS REGULATING THE SALE OF FERTILIZERS.

378 (189). *Sale or exchange of commercial fertilisers; license required.*—Commercial fertilizers must not be sold or exchanged without a license from the commissioner authorizing the person making the sale or exchange to deal therein. All sales or exchanges made without such license are void.

See citations to section 886 (141).

379 (140). *License; fee; duration.*—On the payment of a fee of one dollar, the commissioner must issue license to any person or firm, or corporation, or association of persons, authorizing the sale or exchange of fertilizers during a season, expiring on the thirtieth day of September of each year.

380. *Evidence.*—The printed report of a commissioner or a certified copy of the record in his office showing the issuance of a license to sell or exchange commercial fertilizers, and to whom and when issued, is presumptive evidence of the fact that such license was issued to such person at such date. But this provision does not preclude the introduction of the license in evidence.

386 (141). *Dealer must attach tags, else sales or exchange void.*—Before selling or exchanging, or offering to sell or exchange fertilizers, the licensees must attach one of such tags to each bag, barrel or package containing two hundred pounds or any less number of pounds; two tags to each bag, barrel or package containing more than two hundred pounds and not more than four hundred pounds, and one additional tag for each additional two hundred pounds or fractional part thereof, contained in such bag, barrel or package; and a sale or exchange of fertilizers not so tagged is void.

*A sale of commercial fertilisers, made in violation of statutory requirements, is void, and no recovery can be had for the price.*—Campbell v. Segers, 81 Ala. 59; Steiner v. Ray, 84 Ala. 98; Clark's Cove Guano Co., v. Dowling, 85 Ala. 142; Merriam v. Knox, 99 Ala. 98; Brown v. Adair, 104 Ala. 652; Kirby v. Huntsville Fertilizer & Milling Co., 105 Ala. 529.

*When contract of sale made in this State.*—Johnson v. Hanover Nat. Bank, 88 Ala. 271; Hanover Nat. Bank v. Johnson, 90 Ala. 549; Brown v. Adair, 104 Ala. 652.



*Residence of sellers and place of manufacture of goods are immaterial when delivery made in this State.*—Merriman v. Knox, 99 Ala. 93; Brown v. Adair, 104 Ala. 652.

*Tugs must be attached at the time of the sale; if previously attached, and lost before the sale, others must be supplied, else the sale is void.* Clark's Cove Guano Co. v. Dowling, 85 Ala. 142; Kirby v. Huntville F. & M. Co., 1105 Ala., 529.

*Action on commercial paper given for the price of fertilizers sold without compliance with statutory requirements cannot be maintained, even by a bona fide purchaser before maturity.*—Hanover Nat. Bank v. Johnson, 90 Ala. 549.

*When want of license pleaded, burden of proof on plaintiff.*—Edisto Phosphate Co. v. Sanford, 112 Ala. 493.

387. *Including tag tax in price of fertilizer vitiates sale.*—Whenever any manufacturer, merchant or other person selling fertilizers shall, directly or indirectly, include such tag tax in the price of the fertilizer sold, such sale is void.

388. *Contracts for sale of fertilizers at fictitious prices; only real market value recoverable.*—In contracts for the sale of fertilizers in which an excessive or fictitious price is put upon such fertilizers with the stipulation that if such fertilizers are paid for on or before a certain date they may be paid for in a smaller sum than such excessive or fictitious price, or in cotton or other produce at an excessive or fictitious price, the difference between the excessive or fictitious price charged for the fertilizers and their real market value shall be held a penalty; and in all suits to enforce such contracts only the real market value of such fertilizers, with the interest thereon, shall be recovered.

38. *Parol evidence competent.*—Parol evidence is competent to show such market price, the situation of the parties and the consideration of such contracts, as in cases of usury, notwithstanding any writing in the premises.

390. (42). *Fertilizers to be submitted to commission.*—Before offering a fertilizer for sale or exchange, the person proposing to sell or exchange must submit to a commissioner a written or printed statement, setting forth—

1. The name and brand under which such fertilizer is to be sold or exchanged, the number of pounds contained in the bag, barrel or package, in which it is to be put upon the market, the name or names of the manufacturers, and the place of manufacturing.

2. A statement setting forth the amount of the named ingredients which they are willing to guarantee such fertilizers to contain: First, nitrogen; second, water soluble phosphoric acid; third, citrate soluble phosphoric acid; fourth, acid soluble phosphoric acid; fifth, potash; and such statement shall be held to constitute a guarantee to the purchaser that every package of such fertilizer contains not less than the amount of each ingredient set forth in the statement, and when such statement sets forth the maximum and minimum of any ingredient, the commercial value shall be estimated upon the minimum alone; but this shall not preclude the party from setting forth any other ingredients which the fertilizer may contain, which as well as the preceding, shall be embraced in the guarantee.

See citation to section 386 (141).

391 (143). *Fertilizers or chemicals for manufacturing to be branded*.—All fertilizers or chemicals for manufacturing or composting the same, offered for sale, exchange or distribution, must have branded upon, or attached to each bag, barrel or package, in such manner as the commissioner may by regulation establish, the true analysis of such fertilizers or chemicals, as claimed by the manufacturer, showing the percentage of valuable elements or ingredients such fertilizer or chemical contains, and its commercial value, calculated upon the standard value of the principal ingredients as set forth in the preceding section as priced by the commissioner of agriculture at the beginning of each season, and in every case the brand must specifically set forth the percentage contained in the fertilizer section, in the terms of that section.

392 (144). *Fertilizers; what not included in term*.—The term "fertilizer," or "commercial fertilizer," used in this chapter, does not include common lime, land plaster, cotton seed meal, ashes, or common salt not in combination.

393 (145). *Chemist of department*.—The professor of chemistry of the Agricultural and Mechanical College is the official chemist of the department. On the application of the commissioner he must analyze and certify the analysis of all fertilizers, samples of which are furnished him; and, at the request of the commissioner, if he can without conflict with his duties as professor, must attend conventions of agricultural chemists, make reports of such matters as he may deem of interest to the department, and render such other services in the line of his profession as the commissioner may require.

394 (146). *Compensation of Chemist*.—The chemist is entitled to

his necessary travelling expenses while on duty assigned to him by the commissioner, payable from the funds of the department as provided in the next article.

395 (147). *Copy of official analysis evidence.*—The copy of the official analysis of any fertilizer or chemical, under the seal of the department of agriculture, shall be admissable as evidence in any of the courts of the State on the trial of any issue involving the merits of such fertilizer or chemical.

## CRIMINAL LAWS.

**SECTION 4153.—***Dealing in fertilizers without submitting statement to Commissioner.*—Any person who manufactures or exchanges, sells or offers for sale or exchange, any fertilizer without first submitting the statement required by law to the Commissioner of Agriculture, must, on conviction, be fined not more than five hundred dollars for each offense.

**SEC. 4154.** *Selling fertilizers without attaching proper tags*—Any person who sells, exchanges or offers for sale or exchange, any bag, package or barrel of fertilizer which has not been tagged as provided by law, must on conviction, be fined not less than fifty dollars for each offense.

**SEC. 4155.** *Using more than once, and counterfeiting tags.*—Any person who counterfeits the tags prepared by the Commissioner of Agriculture, knowingly, or who uses a counterfeit of such tag, or who uses a second time a genuine tag, or who uses the tag of a former season, must, on conviction, be fine one hundred dollars.

**SEC 4156** *Making false certificate of analysis of fertilizers.*—Any chemist, who wilfully makes a false certificate of the analysis, or of the ingredients of any fertilizer intended or offered for sale or exchange, must on conviction, be imprisoned in the penitentiary for not less than two, nor more than five years.

**SEC. 4157.** *Dealing in commercial fertilizers without license.*—Any person who sells or exchanges fertilizers without having obtained a license from the Commissioner of Agriculture, as provided by law, must, on conviction, be fined not less than one hundred dollars for each offense.

**SEC. 4158.** *Fraud in manufacture, sale or exchange fertilizer.*—Any person who commits a fraud in the manufacture, sale or exchange of any fertilizer, or of the ingredients of a fertilizer, must, on conviction, be fined not less than one hundred dollars for each offense.

Special attention is called to the following rules for branding bags for the season of 1901-2.

The words "GUARANTEED ANALYSIS" must be in letters not less than one inch in height. The word "ALABAMA" must be in letters

(all capitals) not less than one and one-half ( $1\frac{1}{2}$ ) inches, and the balance of the guarantee, including the commercial value, must be in letters and figures not less than three quarters ( $\frac{3}{4}$ ) of an inch in height.

When the minimum and maximum guarantee is given, the commercial value must be calculated upon the minimum alone.

In computing the value of the commercial fertilizers the laws of Alabama only recognize the following ingredients: Nitrogen, Water Soluble, Phosphoric Acid, Citrate Soluble, Phosphoric Acid and Potash.

In making your calculations to determine the commercial value, you will confine yourself to the foregoing ingredients and to the following values:

Water Soluble Phosphoric Acid	5 cents per pound.
Citrate Soluble Phosphoric Acid	5 cents per pound.
Nitrogen	16 cents per pound.
Potash ( $K_2O$ )	$6\frac{1}{2}$ cents per pound.

I would respectfully call your attention to the fact that it is the opinion of our Attorney-General that every Fertilizer Dealer or Manufacturer who sells goods in this State must obtain a license before offering their goods for sale. Failure to obtain such license not only makes the sale void and the debt non-collectible, but subjects the seller to a fine of one hundred dollars for each sale made. The license fee is only one dollar. The fertilizer season runs from October to October, and I would suggest that you send for your license at the beginning of the season.

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## ALL COMMERCIAL FERTILIZERS MUST BE ANALYZED BY THE STATE CHEMIST.

### AN ACT

To Amend Subdivision 18, Section 147 of the Code.

Section 1. *Be it enacted by the General Assembly of Alabama,* That subdivision eighteen of section one hundred and thirty-seven of the Code be amended so as to read as follows: It shall be the duty of the Commissioner of Agriculture to obtain samples of each and every brand of fertilizers sold and exchanged, or offered for sale or exchange, in this State, for each season in which such fertilizers are offered for sale, and cause such samples to be analyzed by the

State Chemist; and make publication of such analysis not later than August 1st of each year; *Provided*, that the provisions of this act shall not take effect until after September 1, 1891.

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## HOW SAMPLES SHALL BE DRAWN.

Special attention is called to the following rules for sending samples of Fertilizers to have analyzed. Farmers and others sending fertilizers for analysis must observe the following directions:

In order to secure a representative sample of fertilizers to be analyzed, a small amount of material should be removed from the interior of a number of sacks and the samples thus obtained should be thoroughly mixed in order to secure uniformity. At least 6 or 8 ozs. of the material are then placed in a wide mouth glass bottle, which is then sealed and properly labeled. In the case of ton lots of fertilizers, at least every third sack should be sampled in order to secure a final sample, which will approximately represent the whole lot.

The sample should be drawn in the presence of two reliable witnesses and the label attached to the bottle should contain the name of the manufacturer and the name of the goods as taken from the bag in which the fertilizer is sold.

The sample is shipped to Commissioner of Agriculture, at Montgomery, Ala., with transportation prepaid, to be forwarded to the State Chemist at Auburn, Ala.

## TO FERTILIZER MANUFACTURERS AND DEALERS.

In accordance with the provisions of Bulletin 11, page 105, no sample of fertilizers for official analysis will be received by this department until further notice, from manufacturers direct, except in the case of manufacturers within the State, who are licensed dealers and sell direct to consumers.

Such manufacturers can supply samples for analysis under the same terms as dealers, provided such samples are taken from large lots of goods as manufactured for the trade; and provided, further, that only one representative sample of each brand shall be submitted

for analysis by any given manufacturer, said samples being forwarded for analysis not earlier than December 1st.

Samples of the various brands offered for sale in this State will be obtained chiefly from dealers and consumers, and only from manufacturers when specially requested by this department, and such samples should be taken from goods as actually in stock after commencement of the fertilizer season.

Manufacturers who desire to secure analysis of samples drawn and forwarded by themselves, can have such analysis made at a moderate cost by forwarding samples direct to the State Chemist at Auburn, Ala.

R. R. POOLE,  
Commissioner of Agriculture.



Sci 1623.25,4

BULLETIN No. 116.

SEPTEMBER, 1901.

ALABAMA.

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,  
AUBURN.

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## Texas or Acclimation Fever.

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By C. A. CARY.

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MONTGOMERY, ALA.  
BROWN PRINTING CO., PRINTERS & BINDERS.  
1901.



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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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### NOTICE.

Bulletin No. 115 treats of the chemical analysis of commercial fertilizers made by the Chemist for the State Department of Agriculture. Since the bulletin is issued by the Department in large number and generally distributed among the farmers of Alabama, the Experiment Station has printed a limited edition for its own use, and copies will only be sent to the Station Libraries and the Directors of the Stations and a few other parties who are keeping files of the Bulletins for binding. But Bulletin 115 will be sent to any person applying for it until the issue is exhausted.

P. H. MELL, *Director.*

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## **TEXAS OR ACCLIMATION FEVER,**

BY C. A. CARY.

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### **INTRODUCTION.**

The cattle breeding industry of the South has been held in check by the fact that Northern-bred and imported cattle could not be brought into the South without running great and unprofitable risks. In fact, the danger of losing such cattle was so great as to prevent or prohibit bringing fresh and imported strains of breeding animals into the infected regions of the South. As a result of this natural barrier, few beef-bred cattle came to improve the scrub stock or to improve the animals that had a tinge of Jersey blood in them. Possibly Jersey blood is more widely scattered among the native scrub cattle of the South than that of any other breed. Consequently, with a well-bred Jersey bull to head a herd, one could soon develop a respectable and profitable herd of grade Jerseys by using such a bull upon selected native Southern-bred cows. But none of the native Southern cattle have beef tendencies. Most of them do not mature until six or seven years old, and when mature they are too small for profitable beef animals—especially for shipping to distant markets. Beef animals must mature before they are three years old or they are not profitable.

The necessity for animal industry, especially cattle raising—is fast dawning upon the farmer of the South. It leads to diversified farming; it decreases the demand for commercial fertilizers by supplying larger quantities of manurial fertilizers that can be made upon the farm

and are far better than commercial fertilizers, because they are cheaper, and more permanently improve soil, both in mechanical condition and in available plant food. Feeding animals upon the farm and saving the liquid and solid manures gives the farmer a double use of the feed stuffs produced on the farm; because the manurial products contain from 60 to 90 per cent. of all the fertilizing materials that were found in the feeds that were fed the animals. For example: Cotton seed hulls and cotton seed meal lose but very little of their value as fertilizers by feeding them to cattle, providing the the liquid and solid manures coming from the animal are properly saved and utilized. The cattle industry does not mean that we shall not raise cotton, but that we can raise as much or more cotton than we do now upon less acreage and with less work and less expense for fertilizers.

During the past three years more beef-bred animals have been brought into the State of Alabama than during any previous time in its history. Unfortunately, some of them have been lost by acclimation or Texas fever; but the larger number of them have been saved by careful handling. Methods of acclimating or immunizing Northern-bred or foreign-bred cattle have been developed so that the dangers of acclimation have been reduced to the minimum—so that it is no longer unprofitable to bring into the South highly-bred breeding animals.

The chief object of this bulletin is to describe the methods of immunizing susceptible cattle to Texas fever, and give the records that have been made at this station and others by using the improved methods of immunizing Northern and foreign-bred cattle.

## WHAT IS TEXAS FEVER ?

In various parts of the country this disease is known by different names; it has been called Texas fever, acclimating fever, Southern fever, tick fever, Spanish fever, red water, hæmaturia, black water, murrain, dry murrain, yellow murrain, bloody murrain, hollow-horn and hollow-tail.

Texas fever is caused by a very small animal parasite (*Pyrosoma bigeminum*, Smith) which was discovered by Theobald Smith in 1889. Its chief place of living is in the red blood cells of cattle. In some condition it lives in the cattle tick and is carried from immune cattle or cattle sick with Texas fever, to non-immune or susceptible cattle by the tick. In this transmission of the microparasite from the diseased to the healthy animals, it passes through two generations of ticks. The female tick abstracts blood from its host; falls to the ground, deposits a large number of eggs that hatch in 14 to 45 days, and the young seed ticks get upon susceptible cattle and inoculate them. In many cases the fever appears in the cattle about the time the young ticks molt the second time; then the young ticks are about one-eighth of an inch long, and the careless observer may declare there are no ticks on the animal sick with Texas fever. It may be here stated that this micro-parasite has two hosts (cattle and ticks of two generations) and possibly can not live anywhere outside these two hosts. At least its existence in other hosts or places have not been discovered. In some respects it resembles the malarial parasite of man, but its stages of development, are not as well known as those of the malarial micro-parasite. Yet some things are known of its form and life history in the red blood cells of cattle, and in the plasma of the blood. In mild cases of

Texas fever the micro-parasite appears as a single round body in the red cell near the periphery or the outer border. Sometimes there may be two of these round bodies in a single red cell of the blood. Occasionally the small round bodies may appear singly or in pairs in the plasma of the blood. In severe cases that usually occur in hot weather and when the temperature of the animal is high, there may be two spindle or pear-shaped bodies in one red cell of the blood. According to Smith 5 to 50 per cent. of the red cells of the blood may contain these micro-parasites—the number of red cells infected will vary with the type (mild or acute) of the fever. The number of red cells infected will also vary with the different organs from which the blood is taken for microscopic examination. Blood from the capillaries of the liver, heart-muscle, and kidneys, contain from 20 to 50 per cent. of infected red blood cells; while the blood from the capillaries of skeletal or voluntary muscle and the skin may contain very few (10 per cent. or less) infected red blood cells.

Fresh or dried smears of blood may be examined under the microscope. For fresh smears collect a small amount of blood with platinum loop; place it in the center of a clean cover glass; drop the cover glass, blood side down, upon a clean slide and surround the cover glass with vaseline or paraffine; the mount is now ready for examination under the microscope. In making dried smears, take two clean square cover glasses; place a small drop of blood (picked up with the platinum loop) on one of the clean squares a little to one side of the center, and with another clean square spread the droplet of blood over the lower cover glass by attempting to scrape off the droplet with one edge of the upper cover glass, holding the upper one in the right hand inclined at an angle of about 20 degrees, with the lower one the

is held between the thumb and finger of the left hand. Dry the smears immediately after making them, and place them in the hot air oven, keeping them there for one and one-half to two hours, at a temperature 110 to 120 degrees C. Stain the smears with Loeffler's alkaline methyl blue from one to one and one-half minutes; wash in water and dip for an instant into a one-third per cent. acetic acid solution to remove excess of diffuse stain in the red blood cells; wash in water and mount in water or dry and mount in xylol balsam. Examine with a high power objective. (Smith's method.)

The **CHANGES** that **OCCUR IN THE BLOOD** are very characteristic in a case of Texas fever. Red blood cells in great numbers are destroyed by the micro-parasite. This is determined by actual count of the red blood cells in a definite quantity of blood; the test being made before, during and after or following the fever. In healthy old cattle the average number of red blood cells in a cubic millimeter is about 6,000,000. In healthy young calves the average number of red cells per cmm. may be as high as 8,000,000. In healthy mature or middle-aged cattle the average number may be about 7,000,000 per cmm. In acute cases of Texas fever the number of red cells in the blood may be reduced 2,000,000 or less per cmm. In mild cases of Texas fever the number of red cells will vary between 3,000,000 and 5,000,000 per cmm.

As associated with, or as a result of the great loss of red blood cells (anæmia) the red cells will vary in size and shape; some are very much larger than normal red blood cells and when stained with Loeffler's alkaline methyl-blue, become diffusely stained, and some of them contain very small granules. These large red cells are found in some forms of anæmia in man, and are called megalocytes.



The **UNITED STATES GOVERNMENT** has **ESTABLISHED** a **QUARANTINE LINE** which is fixed for the regulation of inter-state trade in cattle, so that Southern tick-infested cattle cannot be taken into non-tick-infested States (except for immediate slaughter) during the warm seasons when pastures and susceptible cattle may become infected with ticks, and the latter inoculated with the micro-parasite of Texas fever. All the States, or parts of States, south of this line are in the tick-infested region, and all north of it are in the tick-free region. This line starts at the Atlantic Ocean, near the southern boundary of Virginia, runs westward, leaving nearly all of North Carolina, all of Georgia, Alabama, Mississippi, Louisiana, and Texas, part of Tennessee, Arkansas, Indian Territory, New Mexico, Arizona, and the southern part of California south of the Governmental quarantine line, in the tick-infested part of the United States.

This quarantine line and the fact that all Northern-bred cattle shipped into the South have Texas fever, have led many people to believe that Texas fever occurs only in Northern-bred cattle, and never in the native cattle of the South. But it has been proven in some cases, beyond doubt, that calves are not born immune to Texas fever even though their dams are immune. In truth, it is very probable that all cattle are born susceptible to Texas fever, and only acquire immunity after birth, by having one or more attacks of the fever. The micro-parasite in the blood of the dam can not pass into the foetus in the uterus because the blood in the circulation of the mother does not pass directly into the circulation of the foetus. The serum of the blood of the mother passes through membranes into the circulation of the foetus and it is very probable that the micro-parasite does not pass through these membranes. Moreover, blood serum contains very few of the micro-parasites.

The calves that are born of immune cows and live in tick-infested lots or pastures, acquire immunity while young, by having such a mild attack of the fever that it is not observed. Possibly complete immunity is only acquired by two or more mild attacks that appear as the succeeding broods of ticks inoculate them.

Some of the calves born of immune cows escape tick infestation, and consequently escape inoculation. When full grown, or several years old, they may be taken into a tick-infested pasture or the ticks may be brought to them by introducing new cattle into the herd; then they may die of Texas fever. Many farms in Alabama are tick-free; many town lots are tick-free; parts of many farms and pastures are tick-free; consequently cattle that are bred and raised in such tick-free places are susceptible to Texas fever. Tick-free lots, pastures and farms are so made by keeping all cattle off them for one or more years, by rotation of crops and pastures, by burning the grass, by killing all the ticks on the home cattle, by stock law all the year round, and by introducing no new cattle without first completely ridding them of ticks. Ticks do not travel any great distance (a few feet only), except when upon their host; by themselves, ticks will rarely, if ever, cross a road 60 feet wide. Hence a tick-infested and tick-free farm may be very near each other and remain in that condition, providing cattle and horses are not permitted to go from one farm to the other, except when these farm animals are free of ticks. Records of losses in Alabama of native, Southern-bred cattle, from Texas fever have been reported to me every year for several years, and I have records of Texas fever occurring in Alabama-bred cattle in every season of the year. Of course the severe and fatal cases occur mostly in hot portions of the year, while most cases that occur in winter are mild. One or two illustra-

tions may bring out some of the above-mentioned conditions. A certain dairyman had kept his cattle and farm free of ticks for several years. He bought some new cattle, which were infested with ticks, and placed them in his herd. In due time his home-raised cows began to die with what he called "red water," which was Texas fever. Another man sold his entire herd of cattle that had been kept free of ticks; these cattle were moved just a few miles, and in a short time many of them died of Texas fever. Parties who buy calves or feeders from various farms in a neighborhood, beat or county, nearly always lose several some time after the calves or feeders have been brought together in the new feeding pens or pastures.

It might be well to state here that Hunt of Australia claims that some cattle ticks do not possess the micro-parasite of Texas fever—especially in a virulent form. This might explain some of the outbreaks of Texas fever among Southern-bred cattle in herds that are collected from many different farms or pastures. But so far as I know, all ticks of this species in the United States that have been tested, have been able to transmit the micro-parasite; and no positive facts have been discovered that show that the micro-parasite will vary in its virulency. Hence we must regard all ticks of this species as carriers of the Texas fever micro-parasite.

**THE SOUTHERN CATTLE TICK** (*Boophilus bovis*, Riley), is said to be a native of Northern Africa, and reached the Southern States by way of Spain, South America, Central America and Mexico. The life history of this tick, as discovered by Cooper Curtice, is described as follows:

The large female tick (the one so easily observed on cattle) drops to the ground when filled with blood from

its host; hides in some secluded place; lays or deposits from 1,500 to 3,000 eggs, and then dies. The incubation period, or time required for the eggs to hatch, will vary from 14 to 45 days; the length of time depends upon varying conditions of temperature and moisture. Warm weather and a little moisture shortens the period of incubation; cool weather or heavy rains prevent or retard hatching of the tick's eggs and destroy many young ticks. The small ticks fresh from the eggs are six-legged, and very lively, collecting in bunches, not unlike in appearance a mass of chicken mites. They are called "seed ticks" because they look like a small seed or because they are said to be the seed of the tick. They crawl or climb upon grass, weeds or any object near the place of hatching. Cattle passing through the grass or weeds will become infested with "seed ticks," which soon attach themselves by their mouth parts to the skin of their host. In 12 to 15 days the "seed tick" molts ("sheds its skin") and then possesses eight legs (4 pair) instead of six. A second molting occurs in from four to six days after the first, and following this second molting, the female tick very soon becomes larger than the male; the male possesses pointed shoulders, and never gets much larger after the second molting. The female engorges itself with blood from its host, and thus develops into the large, plump, fat tick that can be so easily observed upon infested cattle, and when mature drops to the ground and dies laying eggs. Thus the round of life is completed.

### **COULD ALABAMA OR THE ENTIRE SOUTH EXTERMINATE THIS SPECIES OF TICKS ?**

According to some authorities tick extermination is possible. One farm, one beat, one county can be made tick-free. Why not an entire State? If every cattle

owner in Alabama would voluntarily (or by compulsion) fight for the extermination of the tick it might be accomplished in two years. But extermination would now be next to impossible in the free-range counties of Alabama. It could be much more easily accomplished in stock law counties where the cattle are not permitted to run at large during the entire year. Every cattle owner being required to keep his cattle confined to his own pastures or definite limits could, by use of dips or washes, destroy the ticks on his cattle, horses and mules. He could also change his pasture from one part of his farm to another, at least once a year, or as often as he applies some dip or wash to the cattle to kill the ticks. The best time to get rid of the ticks on the cattle is in the winter when there are very few ticks. Once getting the cattle entirely free of ticks, they could then be put in a pasture where no cattle had been for one year or more. Following this the cattle must be inspected closely once every week, and if ticks should appear again kill them with dips and washes. Three applications of a tick-destroying dip or wash should be made; the second application should be given about ten days after the first, and the third about ten days after the second. The cattle are then ready to go into the tick-free pasture. If the herd is large it would be best to construct a dipping tank large enough to immerse one animal at a time. The tank might be wholly or partly sunk into the ground, having a pen and approaching chute, and a draining platform near the exit chute. The Bureau of Animal Industry at Washington, and Dr. Francis of College Station, Texas, have used large dipping tanks, and by applying to either of them by letter, plans and methods of constructing such tanks might be secured. Beaumont oil floating on warm water in the tank could be used to destroy ticks. It is cheap, and

could be applied full strength. Cotton seed oil or kerosene oil emulsion can be used, but they are more expensive than Beaumont oil. Where a farmer has only a few cattle the Beaumont oil could be applied with cotton lint or rags by putting each animal in a brake or chute and going over the animal thoroughly with the oil.

All new animals entering the herd must be made tick-free before being turned into the pasture with the herd.

What would be gained by having Alabama or the entire South free of ticks?

The most important advantage would be free and unrestricted cattle trade with the North, and all of Europe at all seasons of the year. You could then bring into the South cattle from the North at any season of the year without danger of loss from Texas fever. If Alabama or any Southern State were to produce "feeders" or "stockers" they could be shipped directly to the corn belt States at any season, and not be hampered by a quarantine extending from March or April until November or December. In short, the entire train of troubles coming from Texas or Southern cattle fever would be wiped out. All of this would be most desirable if all the tick-infested States would line up and completely exterminate the tick. But if one county or beat should exterminate the ticks within its borders (unless it be adjacent to the Government quarantine line), it would be in a great deal of trouble by its isolation. Unless adjacent to the quarantine line it could not ship its cattle out only at such times as could the tick-infested counties. Moreover, breeders in the tick-infested counties could not buy cattle in the tick-free county because such cattle are as susceptible to Texas fever as the Northern-bred cattle. Cattle from tick-infested counties could not be taken into a tick-free county without keep-

ing them in quarantine until they are made tick-free by dipping, etc.

The question of extermination of the tick resolves itself into this: It is a good thing for counties of townships contiguous to the Government quarantine line to make a fight to exterminate the tick and have the quarantine line moved South of them. But to commence in the center of a tick-infested State would only lead to trouble by increasing the number of outbreaks of Texas fever or by completely shutting off tick-free places from cattle trade with surrounding territory. I would not advise local tick extermination in Alabama except to get small pastures or places for acclimation purposes, and such places are not absolutely necessary for the new methods of acclimating Northern or foreign-bred cattle. Now this does not mean that any cattle owner should permit his cattle to become literally covered with ticks, but instead every cattle owner can keep off the excessive number of ticks and yet have a sufficient number of ticks to keep his cattle immune and to permit the calves to acquire immunity. No doubt excessive tick infestation retards the growth and development of beef cattle, and also the milk-producing capacity of the milch cow.

### **HOW TO RECOGNIZE AND DISTINGUISH TEXAS FEVER IN THE LIVING ANIMAL.**

1. Learn the history of the diseased cattle. Were they bred and raised in a tick-infested or a tick-free region? Were new ticky cattle brought into the herd, or were the sick cattle put into a new pasture where ticks are present, either upon cattle or in the pasture? Look carefully for the small ticks upon the sick cattle. It takes an inexperienced person some time to find the small, young ticks. In some cases the ticks may have

been entirely or partially removed by use of oils or drugs or dips, but not until after the ticks had inoculated the animal.

2. The temperature of a tick-inoculated animal may rise before any other symptoms are observed. In mild cases the temperature will range between 103 and 105; in severe cases it may vary from 105 to 108 degrees Fah. The temperature may remain above normal a few days then drop to normal (102) for a few days. In chronic cases there may be variable or regular periods of alternate rising and falling of the sick animal's temperature. (See Admiral's temperature record in Table No. II.)

3. In mild cases the appetite is capricious or changeable. The sick animal may refuse feed at one time, and at another eat quite or nearly a normal or full feed. In acute or severe cases the appetite is entirely or almost completely lost; the sick animal may nibble at this or that feed, but will eat very little. Rumination is suspended (does not chew the cud) in all severe cases, during the high fever period, and some times until convalescence begins; this would lead some persons to claim that the animal was sick from "loss of cud."

4. At first or during the high fever period, the bowels are inactive. Loss of appetite, ceasing to ruminate and inactivity of the bowels indicate that digestion is suspended. The inactivity of the bowels may be indirectly a result of loss of red blood cells, a result of the high fever, or it may be due to congestion and sometimes inflammation of smaller or larger areas of mucous membrane lining the fourth or true stomach and of the intestines. Sometimes upon post mortem examination the mucous membrane of the fourth stomach and of intestines are found eroded or ulcerated—the membrane in small spots or patches has sloughed off. No doubt that the bowels are paralyzed, and no amount of heavy



purgatives will move them in that condition. Very probably many cases are killed by frequent doses of heavy purgatives, when small oleaginous (raw linseed oil) laxatives should be given to soothe the inflamed areas. Fermentation may be kept down by giving dram doses of creolin in one-half pint of water three or four times per day. When the animal's condition changes for the better, or begins to improve, the bowels may then become freely active; but in no case should the active bowels be checked; this will be corrected as the animal improves.

5. The respirations may be slightly accelerated, but in acute cases they are very rapid, running as high as 30 to 60 per minute. The rapid respirations are short or shallow, and in some cases are accompanied by a cough and sometimes by groaning or grunting sounds.

6. The pulse in acute cases is rapid and as the number of red blood cells decrease, the pulse grows weaker. The weakness of heart and blood vessels and general muscular weakness cause the patient to lie down much of the time. When it attempts to walk the gait is wabbling, staggering, unsteady equilibrium. Sometimes the sick animal stands with depressed head and arched back.

7. The kidneys are usually quite active. Large quantities of urine are passed. In mild cases the urine is darker than usual and in severe cases the urine may be blood red (port wine color). This excess of color is the coloring matter from the broken-down red cells of the blood, and it is excreted from the body largely by the kidneys. The red colored urine does not contain blood, yet it leads many to call the disease "bloody murder" or "red water." Remember that all acute cases or fatal cases do not pass red urine, but out of a number of sick animals in a herd some of the severe cases will pass red urine.

8. In some cases the eyelids become swollen so much that the animal can hardly open the lids sufficiently wide to see. Many cases are accompanied by a more or less prominent swelling under throat or root of the tongue, between the branches of the lower jaw.

As a rule the sick animal becomes separated from the rest of the herd; if weather is warm it seeks the shade, stands with arched back and shrunken abdomen, or lies down from weakness. In cool weather, or during the winter season, many cases perish largely from exposure to cold nights and cold rains.

**EXAMINATION AFTER DEATH** may help one in making an accurate decision in regard to the disease causing the death of the animal. Post mortem conditions are sometimes quite characteristic and constant; yet in some instances some of the common characteristics may be absent or not sufficiently marked as to be recognized. The condition of the carcass as to flesh will vary with the length of time the animal was sick, and the type or severity of the disease. As a rule a few days of high fever that suspends all digestive action will lead to rapid emaciation. In cutting through the skin notice that there is very little blood in it or the tissue just under the skin, and the small amount of blood in the skin is pale, and does not readily coagulate. After opening the abdominal cavity, examine the liver, the spleen, the kidneys, the bladder, the stomachs, and the intestines. If the animal died in one to three days after becoming sick the liver may be very large—engorged with blood and bile, giving it a rather dark brown color; but if the animal lived a number of days after becoming sick the liver will be engorged with bile and will have a deep yellowish tinge; this yellow color is very prominent upon a cut surface of the liver. The gall bladder is usually

excessively distended with thick flaky bile. The bile is said to be thicker and more flaky in cases that were sick several days before dying than it is in cases that die in a short time after becoming affected.

The spleen or "melt" is generally much larger than it is in the healthy animal; it may be three or four times as large as a normal, healthy one. It is darker than a normal one, and when cut open its bluish-black contents slowly flow out. There are some genuine cases of Texas fever in which the spleen is not very much enlarged or changed in color and structure.

The mucous membrane lining the fourth stomach and intestines may be inflamed or eroded in spots or patches; cut them open and wash away the contents so that the red, inflamed or ulcerated condition may be distinctly observed. In some cases the contents of the fourth stomach and of the intestines in places may be tinged with blood; if the intestinal contents are hard and firm they may be surrounded by a gelatinous material or exudate that is in places tinged with blood.

In severe cases when the animal dies early in the course of the disease, the kidneys may be enlarged and they may have a uniform brownish red color throughout their entire structure. Cover glass smears made with blood taken from the kidneys will show that a very large per cent. of the red blood cells contain the micro-parasite. The bladder will usually contain more or less dark brown or red colored urine. The color is produced by the hæmoglobin that is held in solution in the urine and comes from the disintegrated red cells of the blood. The urine also contains albumen.

The white membranes or tissues of the body—such as the serous and mucous membranes, the connective tissue under the skin, etc.—may become tinged with yellow very like the jaundice yellow in man. This is most

prominent or marked in chronic cases or cases of long duration.

The heart, according to Smith, has the right ventricle "distended with blood, fluid or clotted, according to the time elapsing between death and the examination. The left ventricle is usually firmly contracted and may contain a small quantity of fluid or clotted blood." The small extravasations of blood under the epicardium and endocardium are quite constant; they are most numerous on the outside and inside of the left ventricle.

### **WHAT IS IMMUNITY TO TEXAS FEVER ?**

**IMMUNITY** means that an animal is not susceptible to Texas fever. It is now believed that an animal can acquire immunity only by having the disease—one or more attacks. One severe attack of the fever or two or more mild attacks usually insure a safe immunity.

Immunity will last as long as the life of the animal, if said animal becomes infested with ticks one or more times each year of its life. But my observation of the disease, as it occurs in native Alabama-bred cattle, leads me to believe that immunity can be lost in two or three years by keeping the animal free of all ticks. I am confident that loss of immunity in this way explains the occasional outbreak of Texas fever in herds that have been kept free of ticks for two or more years, and then letting the cattle become infested with ticks.

### **METHODS OF PRODUCING IMMUNITY TO TEXAS FEVER.**

The natural method is the one in which the ticks do the inoculating. Four different forms of tick inoculations have been tried. In many instances Northern-bred cattle were brought into the South, turned out with the herd; permitted or forced to "rough it," and survive or

perish with slight or excessive tick inoculation and poor care. Fifty to ninety per cent. of Northern-bred and imported cattle so treated died—a mortality too great to be profitable. A modified form of this careless way has been employed by many with much more favorable results. The susceptible animals are kept by themselves in barns, pastures and lots separated from native Southern cattle; at the same time a few ticks are allowed to get on the cattle, but excessive tick infestation is prevented. In a majority of such animals tick-inoculation occurs gradually. One summer in the South under such conditions has usually produced immunity. However, losses by this means are too great to recommend it when better means can be obtained.

Dr. Connoway of the Missouri Experiment Station and Dr. Francis of the Texas Experiment Station, have tried to control tick inoculation by placing a definite number of young seed ticks upon the susceptible animals at different times. Collect full grown female ticks from Southern cattle and put them in a fruit jar or some vessel having a little moist earth at the bottom. This jar is then placed in an incubator or in the kitchen near a warm chimney or stove; in 15 to 20 days the female ticks will have deposited their eggs and the eggs will have hatched into a mass of lively seed ticks. About 25 of these seed ticks are placed upon each susceptible animal (best time in late fall or in winter) and they will inoculate each animal so that in the course of 10 to 30 days the fever will appear. When the animals recover from the mild attack of the fever (say in 40 to 50 days) a larger number (about 100) of incubator seed ticks are put upon each animal; this should produce a second attack of fever. When the cattle recover from it they are immune and ready for the pasture. At no time in this treatment should the cattle want for good feed and pro-

tection from cold nights and rains. Some losses occur by this method, and it is a little more inconvenient and uncertain than either of the two methods that will be mentioned following this.

The fourth modified form of tick inoculation is the one where sucking calves, 2 to 4 months old, are brought into the South in the fall or winter or early spring, and allowed to take milk from a Southern-bred cow or are fed fresh sweet milk from a Southern cow. While young and during the time before it is weaned, put a few seed ticks upon the calf or permit them to get upon it in small numbers. Natural tick inoculation will then occur when the calf is best able to resist severe fever and to recover from it. It is possible that the milk of a Southern-bred immune cow may have some immunizing power, but I doubt it. I think the milk of a non-immune cow would be as effective because it keeps the calf in the best of condition to resist, and to recover from, the fever or attack of the micro-parasites upon the red blood cells. It is a well-known fact that young calves or cattle do not have Texas fever in as severe a form as do older or mature cattle. All competent observers or investigators of Texas fever have noted that fact. According to Hunt of Australia, (who produced by inoculation the fever in calves born of immune cows), immunity is not inherited. It is very probable that all Southern-bred calves do not inherit immunity, but acquire it after birth by tick inoculation. No doubt that the vast majority of Southern-bred calves have the fever in such a mild form that it is not appreciable. This partial immunity of calves to the fever may be explained by the fact that young animals have a greater number of red blood cells per cubic millimeter than do older animals, and can carry on the functions of the blood better in case of loss of red blood cells. Also, the power of reproducing red

blood cells is greater in the young than in the old animals. This may be due to the fact that there is a relatively greater quantity of red marrow in the young animals, and this red marrow tends to reproduce blood cells nearly as fast as they are destroyed by the micro-parasite. The general vigor of a young animal may add to its resisting and recuperating power. Moreover, it is well-known that young animals exhibit greater power of repairing wounds and recovering from almost any disease than older ones. Broken bones unite quicker and better in young animals than in mature ones. Dr. Francis remarks, this method of immunizing suckling calves is a good and safe way for farmers who have a few animals; but where many animals are wanted on a large ranch it is cheapest to use the defibrinated blood method. One drawback to immunizing calves is that the owner must wait one or two years before the calves develop into breeding animals; it means loss of time but is a safe method.

**The Defibrinated Blood Method** of producing immunity to Texas fever in cattle was originated or discovered in Australia. It has been most extensively employed in this country by Dr. Connaway of the Mississippi Experiment Station, and Dr. Francis of the Texas Experiment Station. It has been tested by the Bureau of Animal Industry at Washington, D. C., and by the Louisiana, the Mississippi and the Alabama Experiment Stations.

Briefly speaking, it consists in inoculating a susceptible or non-immune animal with blood that is freshly drawn from an immune animal and defibrinated. The animal from which the blood is derived should be at least two years old, and Southern-bred, and known to have had ticks upon it some time during the second summer.

mer of its life. A Northern-bred animal, that has acquired immunity by having had an attack of Texas fever within one year, may also be used as a source of blood for inoculation. After securing the animal the following instruments and articles should be prepared for the inoculation:

A sterilized hypodermic syringe, one or two sterilized scalpels or sharp knives, one or two sterilized aspirating needles with an inside diameter of 1 to 2 millimeters; a clean sterilized beaker or wide-mouth bottle, containing a small glass rod, and the bottle or beaker should be plugged with aseptic absorbent cotton; one pair of scissors, a 2 per cent. solution of creolin, and sterilized cotton or sponge, and sterilized distilled water. The water may be sterilized by boiling one hour.

Any or all of the above named articles, except the creolin solution and water, may be sterilized by placing them in a vessel of cold water, and then heating the water until it boils for one hour.

The animal from which the blood is to be drawn may be secured by using a cattle nose-leader or by casting it with ropes, hobbles, etc. Clip the hair very close over a space 3 to 6 inches long and 2 inches wide along the jugular furrow on either side of the neck (just over the jugular vein). Wash the clipped skin with soap and water; then with the creolin solution and then with distilled water. Now cord the neck of the animal as the neck of a horse is corded just before it is to be bled. When the neck is corded the jugular vein stands out prominently. Now the aspirating needle, with its point inclined toward the head, is pushed into the jugular vein and the blood that escapes through the hollow needle is caught in the sterilized breaker or wide-mouth bottle, and stirred slowly with the glass rod, being careful to



hold the cotton plug over the mouth of the breaker or bottle while stirring. As the fibrin collects in clots on the glass rod, it may be lifted out, and by a quick jerk of the rod the clot is dislodged from the rod and the rod is then returned to the breaker or bottle, and the blood is stirred until no more fibrin collects on the glass rod. In the breaker or bottle will remain nearly all of the red blood cells floating in the blood serum and some of these red blood cells will contain the micro-parasites that cause Texas fever. This defibrinated blood should be kept warm (above 90 degrees Fah.) and when the susceptible animals are ready for inoculation, the defibrinated blood may be drawn into the warm hypodermic syringe and 1 cc injected under the skin of each susceptible animal. Remember that it is essential that the defibrinated blood should be kept warm and that the inoculations should be made as soon as possible after the defibrinated blood is prepared, because it may become cool, or contaminated with septic or pus germs. It is best to have the cattle that are to be inoculated confined by halter or chains or stanchions in stalls. I should not advise the use of defibrinated blood that is over an hour old.

In about six to ten days after the inoculation the temperature of the inoculated animals will rise, ranging between 103 and 106 degrees Fah. The fever may continue from 3 to 15 or more days; then fall to normal (102); a secondary fever usually begins about the thirtieth day after the inoculation and may continue for several days. According to Pound, Francis and Connoway the primary inoculation fever appears in 6 to 10 days, and the secondary inoculation fever appears about the thirtieth day after the inoculation. The primary inoculation fever, as a rule, is more regular or will occur with greater regularity than the secondary inoculation

fever. In many cases the primary inoculation fever will be constant and regular, thereafter the temperature may rise and fall irregularly. In rare instances there may be a low continuous fever covering 20 to 40 days. Again there may occur but one fever period and that occur 20 to 30 days after the inoculation. As a rule, it requires from 40 to 50 days to pass through the inoculation fever periods. After recovery from the first inoculation, a second one is given to each animal. In case the first inoculation does not produce a fever running up to 105, it is always best to give a second inoculation and increase the dose of defibrinated blood; if 1 cc was employed in the first inoculation, use 2 cc of defibrinated blood in the second inoculation. As a rule, the second inoculation produces fever periods as in the first inoculation, but the fever is milder than it was following the first inoculation.

Inoculations to produce immunity to Texas fever should be made in the South sometime between Nov. 1st and the following March 1st, and never during hot weather. During the early spring or during the winter, immediately after the cattle have recovered from the inoculation fever, permit a few ticks to get on them. And when the hot weather of June, July, August and September comes, keep off the excess of ticks by applying once per week over places where ticks are most frequently found on the animals, crude Beaumont oil, or a 20 per cent. kerosene oil emulsion.

Immune animals are injured to some extent by supporting an excessive number of ticks.

In looking for accurate results from a large number of inoculations I wrote Dr. Francis of the Texas Experiment Station, and he kindly gave me the valuable facts which you may see in his letter published below.

Notice that out of 1,500 animals inoculated by him per cent. were lost by inoculation fever and less than per cent. by exposure to tick inoculation after recovery from defibrinated blood inoculation. Remember that the vast majority of the cattle inoculated by him were placed in large pastures on ranches where little or no attempt was made to keep off ticks; and that in many previous instances Northern-bred cattle under like conditions had a mortality as high as 50 to 90 per cent.

College Station, August 5, 1901.

Dr. C. A. Cary, Auburn, Ala.

Dear Doctor—I have your letter of the 2nd regarding our experiments with Texas fever. I am preparing a bulletin on the subject now and hope to have it off within six weeks. I have inoculated about 1,500 calves. These run all the way from a few months old to two years of age. I cannot tell you without several hours' work just how many of each age. I may say, however, that the best age is about one year old. The best time of the year is any time from November to March.

We consider one cubic centimeter as a standard dose. We use all the way from one-half of one cc to two cc, but one cc is a standard dose. We take the blood directly from the jugular vein of any Texas-raised animal that is in good health. We usually take something that is two or three years old, so as to avoid the transmission of tuberculosis.

As a general rule, we make two inoculations. I think, however, that one is enough, but we use two merely to insure of an infection. If the time between inoculation and exposure to ticks is several months, I favor two inoculations.

I think that all our calves born in Texas are susceptible to fever, but pass through it while they are still young. I have seen some of our calves with the acute fever and passing red urine that were born and raised here. If they be raised in a pen, say in town, the death rate is pretty high among them, but those that are raised out in pastures the death rate is very low, and the attacks escapes ordinary observation.

The mortality from inoculation fever is about  $3\frac{1}{2}$  per cent. Dr. Conoway has written me the exact number that he has done, and the mortality. It is essentially the same as ours, but I hardly feel at liberty to give you his data. He will certainly supply you with it if you write him. I am yours very truly,

M. FRANCIS.

P. S.—To make a general statement will say that we now save about 90 per cent. of all Northern cattle brought into this country.

M. F.

TABLE I.—Temperature Records of Registered Northern-Bred Cattle, Inoculated with Defibrinated Blood.

DATE.		Admiral.			Baroness			Champion.			Gazelle.			Clementina.			Charley.		
1899.—1900.		A.	M.	P.	A.	M.	P.	A.	M.	P.	A.	M.	P.	A.	M.	P.	A.	M.	P.
Dec. 26.	.....	100.6	.....	100.6	.....	102.6	.....	103.0	.....	102.6	.....	101.6	.....	101.6	.....	101.6	.....	102.6	.....
Dec. 27.	.....	102.0	101.4	101.4	102.2	100.8	100.8	102.2	100.4	102.0	100.4	102.0	100.4	101.6	100.4	100.4	100.4	100.4	100.4
Dec. 28.	.....	104.4	101.8	101.8	100.4	101.6	100.8	102.0	100.2	101.6	100.2	100.0	101.6	100.6	100.6	102.4	102.4	102.4	102.4
Dec. 29.	.....	101.6	102.2	101.2	101.2	101.4	101.4	102.8	101.6	102.8	101.6	101.4	101.2	101.6	101.2	101.2	101.2	101.2	101.2
Dec. 30.	.....	101.8	101.4	101.4	101.4	102.6	101.8	102.2	101.8	102.2	101.8	101.4	101.8	101.6	101.6	102.2	102.2	102.2	102.2
Dec. 31.	.....	101.8	101.8	101.8	101.8	101.2	101.2	102.2	101.8	101.8	101.8	101.4	101.4	102.0	102.0	102.2	102.2	102.2	102.2
Jan. 1.	.....	101.8	102.0	101.8	102.8	102.2	102.2	102.4	101.8	102.2	102.2	101.4	101.4	103.2	101.6	101.6	101.6	101.6	101.6
Jan. 2.	.....	102.0	101.6	101.6	101.8	103.0	101.8	102.6	101.2	102.6	101.2	102.0	102.0	102.2	102.4	102.4	102.4	102.4	102.4
Jan. 3.	.....	102.4	102.0	102.4	102.6	102.6	102.8	102.6	101.4	102.6	101.4	101.0	101.6	102.4	102.4	102.2	102.2	102.2	102.2
Jan. 4.	.....	101.4	102.0	103.4	103.0	101.4	101.4	102.8	101.6	102.4	101.4	101.4	101.4	101.4	100.8	102.4	102.4	102.4	102.4
Jan. 5.	.....	102.2	102.0	104.2	103.6	102.2	102.2	103.6	101.4	102.4	102.4	100.4	101.4	102.0	102.0	102.2	102.2	102.2	102.2
Jan. 6.	.....	101.4	101.4	101.4	104.8	104.6	102.0	102.4	101.6	103.0	101.6	101.2	102.0	101.4	101.8	102.0	101.8	102.0	102.0
Jan. 7.	.....	101.4	102.0	104.2	104.2	104.2	102.0	103.8	103.8	104.6	104.6	100.8	101.0	101.8	102.0	101.8	102.0	102.0	102.0
Jan. 8.	.....	102.0	101.8	103.0	104.8	104.8	102.6	102.2	103.2	103.4	101.4	101.4	101.8	101.8	101.8	102.0	101.8	102.0	102.0
Jan. 9.	.....	101.6	102.8	103.6	104.8	102.6	103.0	103.6	101.4	103.2	101.2	101.6	102.0	101.6	102.0	102.2	102.2	102.2	102.2
Jan. 10.	.....	101.8	101.6	103.8	103.8	103.0	102.5	103.2	104.0	104.2	102.4	101.2	102.4	101.8	102.4	101.8	102.4	102.4	102.4
Jan. 11.	.....	102.2	102.4	104.8	104.0	104.2	104.2	104.0	104.4	104.2	102.2	102.0	102.2	102.2	102.2	102.2	102.2	102.2	102.2
Jan. 12.	.....	101.3	101.6	102.4	103.2	101.8	101.8	101.8	103.4	104.8	101.8	101.8	102.2	101.8	101.0	101.4	101.4	101.4	101.4
Jan. 13.	.....	101.6	101.8	103.0	104.0	101.6	101.6	102.6	104.0	105.4	102.0	101.8	102.0	101.8	102.0	102.0	102.0	102.0	102.0
Jan. 14.	.....	101.6	101.8	103.2	104.6	102.0	102.0	102.1	104.6	104.3	101.2	102.0	100.8	101.6	101.6	101.6	101.6	101.6	101.6
Jan. 15.	.....	101.4	101.8	103.6	104.4	102.0	103.4	103.4	103.4	103.0	101.6	101.6	101.8	101.8	101.8	102.5	102.5	102.5	102.5
Jan. 16.	.....	101.6	102.8	104.1	105.2	102.0	102.0	103.4	102.2	102.6	101.4	101.4	101.8	101.4	101.4	101.8	101.4	101.8	101.8
Jan. 17.	.....	101.4	101.2	103.6	104.8	102.8	102.8	103.2	102.4	102.4	102.4	101.6	101.6	101.6	101.2	102.6	102.6	102.6	102.6
Jan. 18.	.....	102.8	103.4	104.6	105.4	102.3	103.0	103.0	102.8	103.2	103.2	101.0	101.4	102.2	102.2	102.2	102.2	102.2	102.2
Jan. 19.	.....	102.0	102.0	103.6	103.6	103.0	103.0	103.8	102.2	103.6	101.0	101.6	101.6	101.6	101.5	103.0	103.0	103.0	103.0
Jan. 20.	.....	102.0	102.4	103.8	105.0	101.8	101.8	101.4	103.0	104.4	101.4	101.6	101.6	102.2	101.6	102.2	101.6	102.2	101.6
Jan. 21.	.....	101.2	102.0	103.0	104.2	102.2	103.2	103.2	104.0	104.2	101.2	101.2	101.2	101.4	102.2	103.2	103.2	103.2	103.2
Jan. 22.	.....	101.6	103.1	106.2	105.4	102.2	102.2	102.9	103.6	104.2	101.2	101.2	101.4	102.2	103.2	103.2	103.2	103.2	103.2
Jan. 23.	.....	102.0	102.0	102.2	103.4	101.8	101.8	103.2	103.4	103.8	101.0	102.4	102.4	103.0	103.0	103.8	103.8	103.8	103.8

Jan. 24.....	101.6	103.2	102.6	104.0	102.0	103.4	102.8	103.2	101.0	102.2	102.6	103.4
Jan. 26.....	103.4	103.2	102.8	103.4	102.8	104.2	102.6	102.2	101.0	102.6	102.8	103.0
Jan. 28.....	102.2	103.2	102.6	103.0	103.0	104.2	102.6	102.2	101.4	102.0	103.6	103.6
Jan. 29.....	104.0	104.4	102.2	102.8	103.0	106.0	101.8	101.4	102.0	101.8	103.0	103.8
Jan. 30.....	102.0	104.0	102.2	103.2	104.4	106.0	101.4	101.6	101.6	102.0	103.0	103.0
Jan. 31.....	103.4	104.8	103.2	103.4	103.6	106.0	101.6	102.2	102.2	102.2	102.2	102.8
Feb. 1.....	103.0	103.6	103.6	103.6	104.2	105.2	101.4	102.6	101.6	102.8	102.6	103.2
Feb. 2.....	103.0	103.4	102.8	102.4	105.0	105.6	102.4	102.6	101.2	102.8	102.6	103.0
Feb. 3.....	104.0	104.6	103.0	103.6	105.6	105.6	103.4	103.0	102.8	104.2	102.0	102.0
Feb. 4.....	102.6	103.6	102.8	103.6	105.2	105.8	103.0	103.4	102.6	105.0	102.0	102.0
Feb. 5.....	102.8	103.8	103.0	103.0	103.4	105.8	103.0	101.4	102.0	105.6	101.6	101.8
Feb. 6.....	102.6	102.6	102.8	103.0	105.0	105.2	101.8	102.2	101.6	104.4	101.4	102.2
Feb. 7.....	101.2	102.0	103.2	103.4	104.6	104.6	102.0	102.0	102.6	105.0	101.2	101.0
Feb. 8.....	102.8	102.0	102.6	103.0	105.6	105.8	101.6	102.0	101.4	103.0	102.2	102.0
Feb. 9.....	102.2	102.0	103.0	102.2	104.4	103.0	102.4	103.0	102.6	103.4	102.4	101.6
Feb. 10.....	102.0	102.0	103.0	102.6	102.4	102.0	102.2	102.6	102.4	103.2	102.0	101.8
Feb. 11.....	101.2	101.0	102.6	102.6	101.0	102.2	102.0	102.4	102.0	102.0	100.6	101.4
Feb. 12.....	101.4	101.8	103.0	102.6	102.4	101.8	102.4	102.4	102.0	102.2	102.0	101.6
Feb. 13.....	102.0	101.4	103.2	102.8	102.0	102.8	102.4	102.4	102.2	102.0	102.4	101.4
Feb. 14.....	102.0	101.6	103.4	103.4	104.0	101.8	102.0	102.4	101.6	102.4	102.4	101.6
Feb. 15.....	101.0	102.0	102.0	102.0	101.8	103.0	101.8	102.6	101.6	101.6	102.2	102.6
Feb. 16.....	101.6	101.6	102.4	102.4	102.0	103.0	101.8	102.0	102.0	102.0	102.2	101.8
Feb. 17.....	101.2	102.0	102.4	102.8	101.8	102.4	102.0	102.4	101.2	102.0	101.8	102.8
Feb. 18.....	101.8	101.4	103.0	103.2	101.8	101.4	101.8	102.4	101.6	102.0	102.6	101.0
Feb. 19.....	100.8	101.4	103.4	103.6	101.4	102.4	102.4	102.6	101.8	102.4	102.0	102.4
Feb. 20.....	101.2	101.6	103.4	103.6	101.4	103.0	102.6	102.6	100.4	101.4	101.4	101.8
Feb. 21.....	101.8	101.4	102.8	103.4	102.4	102.4	101.4	101.4	100.8	102.0	102.0	102.0
Feb. 22.....	102.0	101.6	102.2	102.4	102.2	102.6	102.2	102.0	102.0	102.0	102.2	101.8
Feb. 23.....	101.2	101.6	102.2	102.2	101.8	101.8	101.4	100.6	100.8	101.4	101.2	102.0
Feb. 24.....	101.0	101.6	101.8	102.6	102.2	103.0	101.4	101.8	101.0	101.4	101.0	102.0
Feb. 25.....	101.4	101.8	101.8	103.0	102.0	101.8	102.0	102.2	101.4	101.8	101.8	102.0
Feb. 26.....	101.4	101.6	101.6	102.6	102.0	102.6	101.8	101.4	102.0	101.2	101.2	102.4

TABLE I.—Continued.

DATE.	Admiral			Baroness.			Champion.			Gazelle.			Clementina			Charley		
	A. M.	P. M.	A. M.	A. M.	P. M.	A. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	A. M.	P. M.	P. M.
1899—1900																		
Feb. 26.....	100.8	104.0	102.0	102.0	102.0	102.0	102.0	102.4	100.4	102.4	102.4	100.8	101.6	101.6	101.6	101.6	101.6	101.6
Feb. 27.....	101.4	103.4	102.0	105.2	101.4	102.8	101.4	102.8	101.8	101.6	101.6	102.0	102.4	102.4	101.8	101.8	101.6	101.6
Feb. 28.....	101.0	101.4	102.0	102.0	102.2	102.6	102.6	102.6	101.2	101.2	101.2	101.0	101.0	101.0	101.4	101.4	101.0	101.0
March 1.....	101.4	102.6	102.2	102.8	101.6	102.8	101.6	102.8	101.4	101.0	101.0	101.2	102.4	102.4	101.8	101.8	101.6	101.6
March 2.....	101.0	102.0	104.4	103.8	102.8	103.2	103.2	103.2	101.2	101.4	101.4	100.8	101.0	101.4	101.4	102.0	102.0	102.0
March 3.....	102.0	103.6	103.6	105.4	101.2	104.6	101.2	104.6	101.2	102.0	102.0	101.8	101.4	101.6	101.6	102.4	102.4	102.4
March 4.....	102.0	102.0	101.0	102.0	101.2	102.4	102.0	102.4	102.0	101.6	101.6	102.0	101.8	101.0	101.0	102.0	102.0	102.0
March 5.....	101.0	102.0	102.0	102.2	102.4	102.2	102.4	102.2	101.6	102.0	102.0	100.8	101.4	102.0	102.0	102.0	102.0	102.0
March 6.....	101.0	101.2	101.6	102.0	103.0	102.6	103.0	102.6	101.4	101.4	101.4	101.2	102.0	101.6	101.6	102.0	102.0	102.0
March 7.....	101.4	101.4	101.8	102.0	102.0	102.0	102.0	102.0	101.4	101.6	101.6	101.4	101.6	101.6	101.6	101.0	101.0	101.0
March 8.....	101.4	101.0	102.4	101.6	102.4	101.8	102.4	101.8	101.8	101.8	101.8	101.6	101.4	101.4	101.4	101.0	101.0	101.0
March 9.....	102.0	102.4	102.4	103.6	101.6	103.4	101.6	103.4	102.0	102.0	102.0	102.0	101.6	101.6	101.6	102.2	102.2	102.2
March 10.....	101.0	102.0	102.8	102.8	102.0	102.8	102.0	102.8	101.2	102.0	102.0	101.0	101.8	102.0	101.8	102.0	101.4	101.4
March 11.....	101.0	102.0	102.2	102.6	101.6	105.0	101.6	105.0	101.6	102.8	102.8	101.4	102.0	101.8	101.8	103.8	103.8	103.8
March 12.....	101.0	102.6	102.0	103.2	102.0	104.4	103.2	104.4	102.2	101.8	101.8	101.4	101.6	102.0	101.8	103.0	103.0	103.0
March 13.....	101.0	102.0	104.0	104.4	101.8	103.6	101.8	103.6	101.8	102.0	102.0	101.6	102.0	101.4	101.4	102.4	102.4	102.4
March 14.....	101.2	101.8	102.4	103.0	103.0	103.4	103.0	103.4	102.2	101.6	101.6	101.4	101.6	102.0	101.6	102.4	102.4	102.4
March 15.....	101.4	101.0	102.0	102.0	103.0	102.4	102.4	102.4	101.2	101.4	101.4	101.4	101.4	101.4	102.4	101.4	101.4	101.4
March 16.....	101.0	101.8	102.4	102.4	102.2	103.0	102.2	103.0	101.4	102.0	102.0	101.4	102.0	101.2	101.2	102.0	102.0	102.0
March 17.....	102.0	102.0	101.8	102.4	102.2	102.2	102.2	102.2	100.8	101.8	101.8	101.4	102.0	100.8	100.8	101.8	101.8	101.8
March 18.....	100.4	101.8	101.4	102.6	101.6	102.0	101.6	102.0	101.0	102.0	102.0	100.8	101.4	100.6	100.6	101.8	101.8	101.8
March 19.....	101.0	101.6	102.2	102.2	102.2	101.0	102.8	102.8	101.2	102.0	102.0	101.2	101.2	100.6	100.6	101.8	101.8	101.8
March 20.....	101.2	102.2	102.8	104.0	101.6	102.8	101.6	102.8	101.2	102.4	102.4	101.6	101.6	101.6	101.6	102.0	102.0	102.0
March 21.....	101.0	102.0	102.8	102.0	101.8	101.6	101.8	101.6	102.0	102.0	102.0	101.2	101.6	102.0	102.0	102.0	102.0	102.0
March 22.....	103.0	101.6	102.4	102.0	102.0	102.2	101.4	102.2	101.2	102.0	102.0	101.2	101.2	102.2	102.2	101.4	101.4	101.4
March 23.....	101.0	101.0	102.4	102.0	101.0	102.2	101.0	102.2	101.0	101.2	101.2	101.4	101.8	101.4	101.8	100.6	100.6	100.6
March 24.....	101.0	101.6	102.6	102.6	101.0	102.0	101.0	102.0	101.8	102.0	102.0	102.0	102.4	101.0	101.0	102.0	102.0	102.0
March 25.....	101.2	101.2	102.8	102.2	102.6	102.0	102.6	102.0	101.4	101.4	101.4	101.6	101.6	102.4	101.6	102.0	102.0	102.0
March 26.....	101.4	101.8	103.0	102.4	102.2	102.0	102.6	102.6	101.6	101.6	101.6	101.6	102.0	101.6	102.0	101.6	101.6	101.6

March 27.....	100.6	101.5	101.8	103.2	102.0	102.2	102.2	101.6	102.0	101.4	102.0	101.4	103.0	101.8	102.6
March 28.....	100.8	101.4	101.4	103.6	102.2	102.2	102.2	102.0	102.2	101.8	102.2	101.8	102.0	101.8	102.6
March 29.....	101.0	101.6	101.6	102.4	102.0	102.4	102.4	101.4	102.4	101.2	102.4	101.2	102.6	101.8	101.8
March 30.....	101.4	101.8	101.2	102.4	101.6	102.8	102.8	101.4	102.2	102.0	102.2	102.0	102.6	102.0	102.2
March 31.....	101.6	101.6	101.0	102.8	102.0	102.8	102.8	101.8	102.0	101.2	102.0	101.2	103.0	101.8	102.4
April 1.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	103.2	103.2	103.2	.....	.....	.....
April 2.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102.2	102.2	102.8	.....	.....	.....
April 3.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102.2	.....	.....	.....
April 4.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April 5.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....



TABLE II.

Temperature Records of Registered Bulls which had Texas Fever as a result of Tick Inoculation the first Summer following Defibinated blood Inoculation.

DATE.	Admiral.		Charley.		Champion.	
1900.	A. M.	P. M.	A. M.	P. M.		
August 10	107.0	107.0	107.0	107.0		
August 11	105.8	106.2	106.2	106.0		
August 12	106.4	106.4	105.4	104.8		
August 13	106.0	104.8	103.0	101.8		
August 14	105.0	106.6	101.0	102.8		
August 15	101.8	100.8	101.0	102.0		
August 16	100.0	101.0	101.2	103.0		
August 18	105.4	105.8				
August 19	107.0	107.4	105.0	105.4		
August 20	106.0	105.6	104.8	106.3		107
August 21	105.0	105.4		104.8		
August 22	103.6	105.0	105.0	102.8	106.0	105
August 23	103.0	105.0	101.8	102.4	102.4	102
August 24	100.6	104.8	102.0	103.4	101.0	102
August 25	104.0	104.8	102.0	102.4	103.0	104
August 26	104.0	104.9	101.8	104.0	102.0	104
August 27	104.0	104.2	101.8	102.4	101.2	101
August 28	103.0	105.0	101.8	104.4	102.0	100
August 29	103.0	105.0	101.8	105.0	106.0	105
August 30	103.0	104.2	102.4	104.4	102.8	105
August 31	103.0	104.2		103.6		105
September 1	103.4	104.2		102.0		102
September 2	103.2	103.8				
September 3	103.0	103.9				
September 4	103.0	104.4				
September 5	103.6	104.4				
September 6	103.0	104.2				
September 7	103.0	104.2				
September 8	104.0	103.8				
September 9	103.0	104.8				
September 10	103.0	104.3				
September 11	103.0	104.6				
September 12	103.4	104.8				
September 13	102.8	103.0				
September 14	103.0	103.8				
September 15	102.8	104.6				
September 16	102.8	104.8				
September 17	102.6	103.8				
September 18	102.0	102.8				
September 19	101.6	104.8				
September 20	101.6	104.4				
September 21	101.4	104.4				
September 22	102.4	104.2				
September 23	101.8	104.6				
September 24	101.6	104.8				
September 25	102.8	105.0				
September 26	102.2	103.8				
September 27	102.2	105.0				

TABLE II—Continued.

DATE.	Admiral		Charley.		Champion	
1900	A M	P M.	A M	P M.	A M	P. M.
September 28 .....	103.0	105.6	.....	.....	.....	.....
September 29 .....	102.2	105.6	.....	.....	.....	.....
September 30 .....	101.0	104.6	.....	.....	.....	.....
October 1 .....	101.8	103.8	.....	.....	.....	.....
October 4 .....	104.0	104.6	.....	.....	.....	.....
October 6 .....	103.2	104.4	.....	.....	.....	.....
October 7 .....	103.2	104.6	.....	.....	.....	.....
October 8 .....	.....	103.6	.....	.....	.....	.....
October 9 .....	.....	102.8	.....	.....	.....	.....
October 10 .....	.....	103.6	.....	.....	.....	.....
October 11 .....	.....	102.8	.....	.....	.....	.....
October 12 .....	.....	102.8	.....	.....	.....	.....
October 14 .....	.....	102.8	.....	.....	.....	.....
October 19 .....	.....	103.2	.....	.....	.....	.....
October 20 .....	.....	104.0	.....	.....	.....	.....
October 21 .....	.....	102.8	.....	.....	.....	.....

## CLINICAL RECORDS OF THE ANIMALS INOCULATED WITH DEFIBRINATED BLOOD.

All of the cattle that were inoculated at Auburn were stabled at night, carefully handled during the entire period of inoculation. The ticks were kept off by weekly applications of kerosene oil emulsion. Neither cotton seed nor any of its products were fed them during the inoculation periods. Unless otherwise mentioned, the blood used in the inoculations was derived from a two-year-old Southern-bred Jersey heifer, which had been infested with ticks during its second summer, and had been tested for tuberculosis.

1. Admiral (see Table I), a red poll bull, bred in Illinois, arrived in Alabama Nov. 11, 1899, at the age of ten months, weighing 742 lbs. December 26, 1899, was inoculated with 1 cc of defibrinated blood. Very little, if any, primary inoculation fever occurred; but a fairly good secondary inoculation fever began January 25, 1900 (30 days after the inoculation), and continued until February 4. He was inoculated a second time February 21, 1900, with  $1\frac{1}{2}$  cc of defibrinated blood. A very slight rise of temperature appeared on February 26 and 27, March 3 and 4, and March 22. The inoculation fever periods in this animal were all more or less irregular, very slight or absent, excepting the secondary inoculation fever following the first inoculation. During the entire inoculation periods he exhibited no signs of ill health. Ticks first appeared upon him June 16. July 21 he was very much depressed or dumpish. August 10 he began to breathe rapid and shallow; morning temperature 107, and at noon 108 degrees Fah., remaining at about 106 for the next four days; then it dropped to normal for two days, rising to 107.4 on August 19. His

temperature ranged between 103 and 105 until September 19, remaining above normal nearly all of the time from August 19 to October 1. Thereafter there were normal or irregular rises in his temperature (see temperature record in Table II). When the high temperature began his urine became highly colored (port wine) and was excreted in large quantities; this condition continued for more than a week. The urine contained a large quantity of albumen.

On August 11, about the beginning of the fever, his bowels became inactive; he was first given Epsom salts, and later linseed oil with rectal injections of warm water—the last being given three times per day. But moderate doses of purgatives and large enemas failed to produce a normal action of the bowels for 14 days. His bowels began to act August 26, and the feces were soft, dark in color and many times were covered with gelatinous mucus. His appetite was almost entirely lost; he nibbled at bran, sorghum, hay and grass; he did not ruminate until he began to recover. Digestion was almost entirely suspended. During the suspension of digestion, fermentation and bloating were relieved by giving internally dram doses of creolin, and by using the trocar and canula (tapping the rumen pouch to let out the gas). His weakness caused him to lie down much of the time. About August 26, when he began to improve, his appetite became a little better; digestion and digestion were resumed, and his bowels began to act freely; yet recovery was slow and in fact he was not yet completely recovered. Periods of improvement and periods of depression have appeared irregularly for twelve months. August 8, 1899, two days before the fever began, he weighed 1027 lbs., and September 1, 1900, 805 lbs.; March 30, 1901, 775 lbs.; October 5, 1901, 705 lbs. His appetite, digestion and assimilation

have been deficient; have been below normal, and consequently very little improvement has been made.

August 13, 1900, there were 4,175,000 red cells in 1 ccm. of his blood.

August 20, 1900, there were 4,550,000 red cells in 1 ccm. of his blood.

August 23, 1900, there were 4,400,000 red cells in 1 ccm. of his blood.

August 17, 1901, there were 6,400,000 red cells in 1 ccm. of his blood.

September 26, 1901, there were 7,090,000 red cells in 1 ccm. of his blood.

The treatment of Admiral during the fever was directed toward keeping the bowels active by using rectal injections of warm water, and by giving, per mouth, small doses of raw linseed oil,—creolin and tapping being used to control bloating. Quinine in 30 to 120 grains doses were given every six hours to destroy the micro-parasite which causes the disease. To keep up heart action and tide over periods of great depression and weakness, tincture of digitalis was given in 2 to 4 fluid dram doses; also tinct. of nux vomica was used to stimulate the heart. Gention was given as a stomachic to improve the appetite and digestion after the acute stage had passed; also tincture chloride of iron and Fowler's solution of arsenic were tried, with the idea that they would increase the hæmoglobin and number of red blood corpuscles. But no appreciable results followed the use of the last two named drugs.

**Clemintina** (see Table I), a registered red poll heifer, bred in Illinois, was 1 year old when shipped to Auburn, Ala., arriving November 8, 1899, and then weighed 770 lbs. December 26 she was inoculated with 1 cc of defibrinated blood. She had no primary inoculation fever,

very slight secondary fever appeared February 1 about 36 days after inoculation. February 21 she had a secondary inoculation of  $1\frac{1}{2}$  cc of defibrinated blood. A very slight elevation of temperature occurred 40 days after the second inoculation. Of all the blood cattle inoculated at the same time she was the least. During the shipment she accidentally dropped her calf and aborted July 26. Preceding and following the abortion she had some fever and it is very probable that the abortion was caused by the fever. According to the Australian authorities Texas fever probably by defibrinated blood inoculation is often attended by abortion in pregnant cows. This heifer has remained in the best condition, and has made an almost continuous growth from the time of her arrival in Alabama to the end of her second summer. November following her first summer she weighed 1020 lbs. 2 years old, and on August 10, 1901, she weighed 1200 lbs. She dropped a bull calf about September 20,

**Experiment of Alabama**, (see Tables I and II), a short-horn bull, bred in Missouri, arrived at Auburn, Ala., October 8, 1899, at the age of 7 months, weighing 472 lbs. In shipping he caught cold and had an attack of pneumonia the first week after his arrival in Alabama. October 26 he was inoculated with 1 cc of defibrinated blood. If primary fever appeared it lasted only one day, October 31. A well marked secondary inoculation occurred from January 28 to February 7, beginning 12 days after the inoculation, and continuing 12 days. February 21, 1900, he received a second inoculation of 1 cc of defibrinated blood. The fever periods following the second inoculation were indistinct and irregular. The secondary fever period of the first inoculation

tion he became very sluggish, lost his appetite and decreased about 20 lbs. in weight. This calf was weak and unthrifty when inoculated, and had days of dumpishness and loss of appetite during the entire winter. While the reaction to the inoculation was well marked for only one period, yet he seemed to be affected more by the fever than any of the other five animals that were inoculated at the same time. During the summer of 1900 and of 1901 he became infested with ticks at different times, and for a short time in August had a period of high fever, going as high as 107 one evening (see Table II). Thereafter he made rapid gains, and on August 10, 1901, he weighed 1200 lbs. His growth during the second summer has been very good.

**Sixth Gazelle of Maple Hill** (See Table I), a short-horn heifer, bred in Missouri, arrived in Alabama November 8, 1899, at the age of 11 months, weighing 692 lbs. Was first inoculated December 26 with 1 cc of defibrinated blood. The primary inoculation fever began January 7, (12 days after inoculation), and continued until January 26 (19 days). The secondary inoculation fever appeared about January 31; it was very mild and not distinctly marked. On February 21, this heifer received a second inoculation of  $1\frac{1}{2}$  cc of defibrinated blood, but no distinct fever reaction followed this inoculation. She lost her appetite one or two days, and had one day of short and rapid respirations during the primary fever of the first inoculation. February 16 and 22 a very few ticks were found on her. June 16 several ticks were found on her, having been in tick-infested pasture since April. July 16 she appeared dull and stupid, and July 24 her temperature rose a little above the normal; no doubt she had, at this time, a very mild attack of fever. She passed through the first summer

good gains and growing. At the beginning of inoculation period she weighed 685 lbs. at the close (April 4, 1900), 805. After this she passed her first and second summers and second winter, much of the time in tick-infested pastures. August 10, 1901, she weighed 1060 lbs., and August 11 dropped a fine 77-lb. calf.

**Miss of Alabama**, (see Table I), a full blood Angler, bred in Illinois; arrived in Auburn, Ala., November 8, 1899, at the age of 8 months, weighing 520 lbs. December 26 she was inoculated with 1 cc of defibrinated blood. The primary inoculation fever began January 2 to 4, and continued until about January 10. The secondary inoculation fever appeared about the 15th day of January and first of February. Following the primary fever occasional irregular rises of temperature appeared. February 21, 1900, she received her second inoculation of  $1\frac{1}{2}$  cc of defibrinated blood; the 10th days following the inoculation she had a temperature of 104° and on the 20th day she had a temperature of 104° in the morning and evening. The primary inoculation fever following her first inoculation was good and continued longer than usual, and the heifer then became sluggish on her feed. At time of first inoculation she weighed 540 lbs.; near the close of the primary fever 540 lbs.; at the close of the inoculation periods (April 4), 570 lbs.; November 1, 1900, 700 lbs.; March 30, 1901, 810 lbs.

**Gay Gardner**, (see Tables I and II), an Angus heifer, bred in Illinois, arrived at Auburn, Ala., November 26, 1899, at the age of 8 months, weighing 605 lbs. December 26, 1899, he was inoculated with 1 cc of defibrinated blood. An almost imperceptible primary fever appeared about January 1. The secondary inoculation fever began January 22 (27 days after the inoculation).



lation) and lasted about 10 days. At no time did his fever reach 104. On February 21, 1900, he received a second inoculation of  $1\frac{1}{2}$  cc of defibrinated blood. No fever followed this inoculation. After being infested with ticks some time in June or July, he had a rather severe attack of fever, beginning about August 10, when his temperature ran up to 107. This period of fever lasted three days; his temperature went up to 104-106 for four days. The fever checked his appetite and made him lose some in weight, but rumination, digestion and action of bowels were at no time completely suspended, as in Admiral's case.

August 8, 1900, just before the fever, he weighed 1015 pounds.

September 1, 1900, just after the fever, he weighed 930 pounds.

August 10, 1901, near close of his second summer, he weighed 1450 pounds, when about 30 months old.

#### **REMARKS ON INOCULATION OF THE SIX CATTLE IN TABLE I.**

One positive mistake that we made with the three full blood bulls which were inoculated at the same time as the three full blood heifers, was that they were not permitted to get ticks on them early in the spring immediately following recovery from the inoculation fever. The heifers were turned out with the herd cows and became infested with ticks early in the spring, while the bulls were kept by themselves in small pasture lot, and did not, in fact, get but few ticks on them until July, when the weather was hot, a dangerous time for fever. Another mistake was made in the second inoculation of all those that did not react well to the first inoculation. The second inoculation dose (coming from same source

as first) should have been  $2\frac{1}{2}$  cc instead of  $1\frac{1}{2}$  cc. The fever must be produced by the inoculation at least once and if possible twice before the animal is safely immune. The temperature should run up to, at lowest, 104 to 105.

TABLE III.

Temperature Records of Northern-Bred Grades that were Inoculated with Defibrinated Blood.

DATE	S. H. GRADE		A. GRADE I		A. GRADE II		A. GRADE III	
	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
1899-1900								
Nov. 24	102.0	102.0	104.0	103.0	102.0	102.6	102.6	105.0
Nov. 25	102.0	102.0	102.0	102.0	102.0	102.6	101.6	103.0
Nov. 26	102.0	102.0	102.0	102.6	102.0	102.0	102.2	102.6
Nov. 27	102.0	101.0	102.0	102.0	102.0	102.6	102.2	103.0
Nov. 28	102.4	103.0	102.6	102.0	102.0	103.0	102.0	102.0
Nov. 29	102.2	103.0	102.0	102.0	102.0	102.6	101.0	103.0
Nov. 30	102.4	103.0	102.0	102.6	102.2	102.4	101.4	103.0
Dec. 1	104.0	104.0	102.0	102.6	103.6	104.0	102.6	103.6
Dec. 2	102.4	103.6	102.0	103.0	102.2	103.0	101.4	104.0
Dec. 3	102.4	102.4	102.0	101.6	102.0	102.2	103.0	102.2
Dec. 4	103.0	103.0	102.2	102.6	102.4	102.0	103.0	103.4
Dec. 5	103.2	102.8	102.0	102.4	102.0	102.2	103.4	102.6
Dec. 6	100.0	102.0	102.0	103.0	102.0	102.0	102.6	104.0
Dec. 7	101.6	102.0	102.0	103.0	102.0	103.2	101.6	103.0
Dec. 8	101.0	102.0	102.0	102.6	102.4	103.0	101.6	103.0
Dec. 9	102.6	102.6	103.0	103.6	102.0	102.2	101.0	102.0
Dec. 10	102.0	103.0	102.6	103.6	102.6	103.0	102.6	103.2
Dec. 11	104.0	103.0	103.0	103.2	103.0	103.4	102.6	103.4
Dec. 12	100.0	103.0	102.0	103.4	102.8	102.0	102.0	103.6
Dec. 13	100.6	102.6	102.0	102.4	101.8	103.0	100.8	104.0
Dec. 14	102.0	103.4	102.4	103.0	102.0	103.2	102.6	103.4
Dec. 15	100.0	102.0	102.0	103.0	102.0	102.4	101.4	102.6
Dec. 16	100.2	102.6	102.4	103.0	102.0	103.0	102.2	103.4
Dec. 17	101.2	102.6	102.6	103.0	102.0	102.6	102.4	103.2
Dec. 18	102.0	102.6	103.0	103.0	100.0	102.0	102.0	103.0
Dec. 19	102.2	103.6	102.6	104.0	102.4	103.6	100.0	103.0
Dec. 20	102.2	103.2	102.0	103.0	102.2	103.0	102.0	103.4
Dec. 21	102.6	102.6	102.6	102.8	102.0	103.0	102.4	102.4
Dec. 22	102.0	102.2	102.6	102.6	102.4	103.0	102.6	102.8
Dec. 23	101.0	102.0	102.6	103.0	102.0	103.0	101.0	103.0
Dec. 24	102.2	102.4	102.6	102.6	102.4	103.0	102.0	102.6
Dec. 25	101.0	102.0	102.4	103.0	102.0	102.4	102.2	102.4
Dec. 26	100.8	102.0	102.0	102.6	102.4	103.0	102.2	102.4
Dec. 27	100.0	102.0	102.4	103.0	102.2	102.6	102.2	102.6
Dec. 28	102.6	102.6	102.6	102.6	102.4	102.6	102.0	102.6
Dec. 29	102.0	102.0	102.6	103.0	102.4	102.0	102.0	103.0
Dec. 30	102.2	102.4	102.6	103.0	102.4	102.6	102.0	102.6
Dec. 31	102.0	102.4	102.6	103.2	102.0	102.4	102.4	102.6
Jan. 1	101.0	102.0	102.4	103.2	102.0	102.0	102.2	102.4
Jan. 2	102.0	102.2	102.0	102.2	101.6	102.0	102.4	102.6
Jan. 3	102.0	102.4	101.4	102.6	101.0	102.0	102.2	103.0
Jan. 4	102.2	102.6	102.0	102.2	102.0	102.2	102.0	105.0
Jan. 5	102.0	102.2	102.6	102.6	102.0	102.2	101.2	102.0
Jan. 6	101.0	102.0	102.2	102.6	102.4	102.6	102.0	102.0
Jan. 7	102.0	102.2	102.6	103.0	102.6	102.6	102.4	102.6
Jan. 8	102.0	102.4	102.0	102.4	102.2	102.6	102.0	102.2
Jan. 9	102.2	102.6	102.4	102.6	102.6	103.0	102.6	103.0
Jan. 10	101.6	103.0	102.6	103.0	102.6	102.6	102.0	102.6

TABLE III—Continued.

DATE	S. H. GRADE		A. GRADE I		A. GRADE II		A. GRADE III	
1899—1900.	A M	P M.	A M	P M.	A. M.	P M.	A. M.	P M.
Jan. 11	103.0	103.0	102.6	103.0	103.0	103.2	103.4	103.0
Jan. 12	102.2	101.6	102.0	102.0	102.6	102.4	103.0	102.6
Jan. 13	102.2	102.0	102.0	102.4	102.6	102.6	102.6	103.0
Jan. 14	101.6	102.0	102.6	102.6	102.6	103.0	102.0	102.6
Jan. 15	102.4	102.6	102.6	102.6	103.0	102.6	102.6	102.6
Jan. 16	102.6	102.0	102.6	102.4	103.0	102.6	102.6	102.6
Jan. 17	102.2	102.4	102.6	102.0	103.0	102.6	102.0	102.0
Jan. 18	103.0	102.6	103.2	102.4	103.4	103.0	103.0	102.2
Jan. 19	103.0	102.4	103.0	102.4	103.6	103.0	102.6	102.2
Jan. 20	102.2	102.4	102.2	102.6	103.6	103.0	102.0	102.6
Jan. 21	102.4	102.6	102.0	102.6	102.6	103.0	102.0	102.6
Jan. 22	102.0	102.4	103.0	102.0	102.6	102.2	102.0	102.2
Jan. 23	102.0	102.2	102.0	102.4	102.6	102.6	102.2	102.6
Jan. 24	.....	102.4	.....	102.2	.....	102.6	.....	102.0
Jan. 25	102.0	102.6	102.0	102.6	103.0	102.6	103.0	102.2
Jan. 26	102.0	102.4	102.0	102.6	102.6	102.4	102.4	102.6
Jan. 27	102.0	102.4	102.0	102.6	102.6	103.0	102.0	102.4
Jan. 28	102.0	102.2	102.0	102.6	102.2	102.4	102.0	102.2
Jan. 29	102.0	102.2	102.0	102.6	102.6	103.0	102.0	102.2
Jan. 30	101.4	102.0	102.0	102.0	102.0	102.2	101.6	102.0
Jan. 31	102.4	102.6	102.4	102.6	102.6	103.0	102.4	102.6
Feb. 1	102.2	102.0	102.0	102.4	102.6	102.0	101.0	102.0
Feb. 2	102.4	102.0	102.6	103.0	103.0	103.0	103.0	103.2
Feb. 3	102.0	102.0	102.0	102.2	102.6	102.2	102.0	103.0
Feb. 4	102.4	102.0	102.6	102.6	102.6	102.4	102.6	102.6
Feb. 5	102.0	102.0	102.4	102.0	102.6	102.4	102.4	102.0
Feb. 6	103.0	102.6	103.0	102.6	102.6	102.4	102.6	102.4
Feb. 7	103.2	102.6	103.0	102.0	103.0	102.2	102.6	103.0
Feb. 8	104.0	103.0	103.2	102.6	103.2	103.0	103.0	102.6
Feb. 9	102.6	102.0	103.0	102.6	102.6	102.6	102.0	102.0
Feb. 10	103.0	102.6	103.0	102.6	103.6	102.4	102.2	103.2
Feb. 11	102.0	102.0	102.6	102.0	102.6	102.0	102.0	101.6
Feb. 12	103.4	103.0	102.6	102.0	103.0	102.6	103.0	102.6
Feb. 13	102.6	102.4	102.0	102.4	103.0	102.6	102.0	102.0
Feb. 14	102.6	102.0	102.0	103.0	102.0	102.0	102.6	102.0
Feb. 15	102.0	102.2	102.0	102.6	102.6	102.6	103.0	103.0
Feb. 16	102.6	103.0	102.0	102.6	102.4	102.2	102.4	102.0
Feb. 17	102.6	102.6	102.0	102.4	102.2	102.4	102.2	102.0
Feb. 18	102.6	102.4	102.0	102.0	102.4	102.0	102.0	102.0
Feb. 19	102.6	102.0	101.2	102.6	102.0	102.2	102.0	102.0
Feb. 20	101.6	102.0	102.0	102.4	102.4	102.6	103.0	102.6
Feb. 21	102.2	102.6	102.0	102.2	102.4	102.6	102.4	102.6
Feb. 22	102.0	102.2	102.0	102.1	102.6	102.2	102.6	102.4
Feb. 23	101.2	.....	102.0	.....	102.6	.....	102.6	.....

The four Northern-bred grades that were brought to Auburn, Ala., November 8, 1899, with the six full bloods, were inoculated one month before the full bloods, and were differently handled and fed. They were all inoculated the first time November 24, 1899, with 1 cc of defibrinated blood, derived from the same two-year-old Southern-bred Jersey heifer; and on January 24, 1900, they all received a second inoculation of  $1\frac{1}{2}$  of defibrinated blood. During the inoculation periods they were fed small rations of bran and very poor hay; housed at night and bad days, and allowed the run of a dry lot on good days. (See temperature records in Table III).

**Shorthorn Grade Heifer,** bred in Missouri, about 8 months old at time of arrival in Alabama, and weighed 320 lbs. The primary fever began about November 28 or December 1, and continued until about December 5th. and rose slightly again December 9, 10 and 11. Her temperature came up again December 18, and irregular slight elevations of temperature occurred until the second inoculation on January 24. During this first period a low fever prevailed, and the heifer exhibited weakness and an unthrifty condition. The low fever following the second inoculation was a little higher and more unbroken or continuous than the fever following the first inoculation. This heifer was not in good condition at the beginning of the inoculation periods, and was not fed a sufficient quantity of good feed during the fever. A liberal supply of good feed is always essential during inoculation fever. She was turned into a tick-infested pasture about March 1, and became so badly infested with ticks in April that it was necessary to get her up and treat her with kerosene oil emulsion in order to remove them. This heifer did make some growth during her first summer, but did not begin

rove in a normal, healthy manner until the spring. September 1, 1901, she weighed about 800 lbs.

**Grade Heifer No. I;** bred in Illinois, about 8 months old at time of arrival in Auburn, Ala. About September 8 the primary reaction began. Slight irregularities of temperature occurred every few days until primary inoculation on January 24, 1900. Primary reaction began about February 6, and lasted about 4 days. February 23 she was turned into tick-infested pasture with the herd, and became infested with ticks early in the spring. She made good gains in flesh during the summer, and on November 10, 1900, weighed 725 lbs. During the second summer she developed without any signs of reaction and now weighs about 900 lbs.

**Grade Heifer No. II,** bred in Illinois, at time of arrival in Auburn, Ala., 8 months old, and weighed about 700 lbs.

Primary inoculation fever appeared about December 1. Secondary inoculation fever not very distinctly located, but probably began about January 9. Temperature rises were irregular and very mild, following the first and second inoculations. She never showed signs of ill health and at the end of the inoculation period she weighed 490 lbs. She was turned into a tick-infested pasture and became infested with ticks early in the spring, and never showed any signs of sickness. At the end of the first summer 670 lbs. At the end of the second summer she weighed about 800 lbs.

**Grade Heifer No. III;** bred in Illinois, about 8 months old at time of arrival in Auburn, Ala., and weighed 420 lbs. About December 1 the primary reaction began. The secondary inoculation fever not very distinctly located unless January 7 to 13 or January 18 to 20. It was so regarded. The primary reaction following

the second inoculation began about February 3, and the secondary reaction appearing about February 20. No reaction is high or very distinctly located. This heifer was very wild and mean to handle, and was not fed during the first and second summers and the second winter, as were Nos. 1 and 2. At the end of the first summer she weighed 610 lbs., and in September, 1901, she weighs about 800 lbs. She became infested with ticks the first summer and several times since, but has never exhibited any signs of ill health.

TABLE IV.

Temperature Records of four Registered Angus Calves. Inoculated  
with Brucella Blood.

E	Barnes, H. I		Barnes, H. II		Barnes, B.		Little B.	
	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
13	103.0	102.6	103.0	102.6	102.0	102.2	.....	.....
14	102.0	103.6	102.6	102.6	102.0	103.6	.....	.....
15	102.6	103.0	102.6	103.0	101.6	102.0	.....	.....
16	102.6	103.2	102.6	103.0	102.0	103.0	.....	.....
17	102.6	103.2	102.6	103.2	102.0	103.0	.....	.....
18	102.6	102.0	102.6	102.0	102.0	102.2	.....	.....
19	102.0	103.2	102.0	104.0	101.0	103.0	.....	.....
20	103.0	103.2	103.4	103.6	101.6	103.0	.....	.....
21	103.4	103.6	103.6	105.0	102.0	105.0	.....	103.0
22	102.0	103.6	102.6	103.6	102.0	102.0	102.0	102.0
23	102.6	103.0	103.0	104.0	102.0	102.6	102.0	102.0
24	102.6	102.6	103.0	102.6	102.0	102.0	103.0	102.0
25	102.6	103.0	102.6	102.6	102.0	102.2	102.6	102.0
26	104.6	103.0	103.2	103.0	101.2	102.0	102.0	102.0
27	103.6	103.0	103.0	103.2	101.6	102.0	102.0	102.0
28	102.6	102.2	102.0	102.0	102.0	102.0	102.0	102.0
.....	102.6	102.4	102.0	102.0	102.2	102.0	102.2	102.0
.....	102.6	103.0	103.0	104.0	102.0	103.0	103.0	104.0
.....	102.0	102.6	102.0	102.6	103.0	102.6	104.0	105.0
.....	103.0	103.6	102.6	103.0	102.0	103.0	104.0	104.0
.....	102.6	103.0	102.0	102.6	102.0	102.6	105.0	106.0
.....	102.6	103.0	102.6	103.0	102.0	102.6	106.0	106.0
.....	102.0	102.6	102.6	102.6	102.0	102.0	106.0	105.2
.....	102.0	102.0	102.0	102.0	101.2	102.0	104.2	103.4
.....	102.0	102.6	102.0	102.6	102.0	104.0	102.6	103.0
.....	103.0	103.0	103.0	103.0	103.0	102.6	103.0	103.0
.....	103.0	103.6	103.0	102.6	103.0	103.0	102.6	102.0
.....	102.6	102.6	102.6	102.6	103.0	102.6	102.0	102.0
.....	102.4	102.6	102.4	102.6	103.0	103.0	102.0	103.0
.....	103.0	103.0	103.0	103.0	102.0	103.0	104.4	105.0
.....	102.6	102.4	103.0	102.6	104.0	103.0	104.0	103.2
.....	102.6	103.4	102.0	103.4	101.6	103.0	103.0	102.0
.....	102.2	102.0	102.0	102.6	102.0	102.6	102.0	102.0
.....	102.4	103.0	102.0	102.6	102.0	102.6	102.0	102.0
.....	102.6	103.0	102.6	103.4	103.6	103.0	102.6	101.4
.....	103.0	102.6	103.0	102.6	103.2	103.0	102.6	102.0
.....	102.0	103.0	102.4	103.2	103.0	103.6	102.6	102.2
.....	103.0	103.2	102.0	102.6	102.6	102.6	102.0	102.0
.....	103.0	103.2	102.6	103.2	103.4	104.0	102.4	102.6
.....	102.0	102.0	103.0	102.6	103.0	103.0	103.0	102.0
.....	102.6	102.4	102.6	103.0	103.0	103.4	102.6	102.0
.....	102.2	103.0	102.4	103.0	102.4	103.0	102.0	102.2
.....	102.0	103.0	102.0	102.6	102.6	103.2	102.2	.....
.....	102.0	102.6	101.6	102.6	102.6	103.0	.....	.....
.....	102.0	102.2	102.0	102.0	102.0	102.6	.....	.....
.....	102.6	102.6	102.0	102.2	102.6	103.0	.....	.....
.....	102.0	102.4	102.0	102.6	102.2	103.0	.....	.....
.....	102.6	103.2	102.0	102.0	102.6	102.6	.....	.....
.....	102.6	102.2	102.4	103.0	102.2	103.0	.....	.....
.....	102.6	102.4	102.0	102.0	103.0	102.6	.....	.....
.....	102.6	102.4	102.2	102.0	103.0	103.0	.....	.....
.....	102.0	.....	102.0	.....	102.2	.....	.....	.....



In Table No. 3, "Barnes, H., I," "Barnes H., II," and "Barnes, B.," represent two heifers and one bull. They are full blooded Angus calves about 6 months old at time of their arrival in Alabama, and were bred in Illinois. February 11 they arrived in Auburn, Ala., and February 13 they were each inoculated with 1 cc of defibrinated blood derived from the same two-year-old Alabama-bred Jersey heifer. The inoculation fever periods are fairly well marked (see Table No. IV), but are somewhat irregular. These calves were fed shorts, corn meal, and received daily from 3 to 4 gallons of milk from two Alabama-bred Jersey cows. The milk very probably had no immunizing power, but it kept these calves in excellent condition to withstand the inoculation fever. They all grew and gained in weight during the inoculation period. April 5, 1900, they were taken to the home of their owner, Hon. R. B. Barnes, Opelika, Ala., where they have spent two summers without showing any symptoms of Texas fever. The heifers were turned into tick-infested pastures and the bull was kept by himself in a small pasture where he did not get many ticks on him the first summer. Consequently in November following the first summer the bull was given a second inoculation of  $1\frac{1}{2}$  cc of defibrinated blood. The cattle have suffered no inconvenience from the inoculation, and the exposure to tick inoculation during the second summer.

The "Little B." in Table No. IV. represents an Angus bull calf, bred in Missouri. He arrived at Auburn, Ala., February 20, 1900, and was then about 10 months old. This calf was small and thin at time of arrival, but on February 21 he was inoculated with 1 cc of defibrinated blood from the same Alabama-bred Jersey heifer. Notice by the table that his reactions or inoculation fever periods were better marked than were those of the

Barnes calves. This is partly due to the fact that he was older and was not fed milk to keep him stronger and better able to resist the micro-parasites. He was fed shorts, wheat bran and corn meal, and maintained a growing appetite and made good gains in weight during the entire 35 days he was in Auburn. When shipped to his owner, Mr. W. G. Little, Livingston, Ala., he could not be forced into the small crate in which he came to Auburn from Missouri. This animal has now passed two summers in Alabama, and has never exhibited any signs of Texas fever.

TABLE V.—SUMMARY OF CATTLE INOCULATED WITH DEFIBRINATED BLOOD IN ALABAMA.

No.	Owner.	Breed.	Age.	Native State.	Time of Arrival in Ala.	First Inoculation.	Dose.	Second Inoculation.	Dose.	Deaths from Inoculation.	REMARKS.
3	Expt. Station.	Angus grades	8 mo's.	Ill.	Nov. 8	Nov. 24	1cc	Jan. 24	1.5cc		
1	"	S. Horn grade	8 "	Mo.	"	"	1cc	"	1.5cc		
1	"	S. Horn Bull.	8 "	Mo.	"	Dec. 26	1cc	Feb. 24	1.5cc		
1	"	S. Horn Heifer	1 year.	Mo.	"	"	1cc	"	1.5cc		
1	"	R. Poll Bull.	1 "	Ill.	"	"	1cc	"	1.5cc		Had severe fever following Summer.
1	"	R. Poll Heifer	1 "	Ill.	"	"	1cc	"	1.5cc		
1	"	Angus Bull.	8 mo's.	Ill.	"	"	1cc	"	1.5cc		
1	"	Angus Heifer.	8 mo's.	Ill.	"	"	1cc	"	1.5cc		Given Jersey milk during Inoc.
1	Barnes,	Angus Bull.	6 mo's.	Ill.	"	Feb. 12	1cc	Nov.	1.5cc		"
2	"	Angus Heifers	6 mo's.	Ill.	Feb. 9	Feb. 21	1cc	"	"		"
1	Little	Angus Bull.	10 mo's.	Mo.	Feb. 20	Nov	1cc	"	"		Passed first sum'r without fever
1	Dumas.	S. Horn Bull.	9 mo's.	Tenn.	Nov.	"	1cc	"	"		"
2	"	S. Horn H.	9 mo's.	"	"	"	1cc	"	"		"
1	Mr. G.	Herefords	2 years.	Mo.	Nov.	Mch 13.	2cc	"	"		"
1	T. and P.	Jersey H.	2 years.	Ky.	Winter.	Mch 14.	2cc	"	"	1	The last nine were inoculated
1	Sadler.	Jersey H.	2 years.	Ky.	"	"	2cc	"	"	1	by Fred G. Matthews, of South
1	Proctor.	Jersey H.	18 mo's.	Ky.	"	"	2cc	"	"		Florence, Ala.
1	Thurman.	Jersey B.	2 years.	Ky.	"	"	2cc	"	"		
1	Cohens.	Jersey H.	2 years.	Ky.	"	"	2cc	"	"		
1	Nathan.	Jersey Cow	4 years.	Ky.	"	"	2cc	"	"		
1	"	Jersey Calf.	6 mo's.	Ky.	"	"	2cc	"	"		

The total number of cattle inoculated was 27, and out of this number two died of inoculation fever and one was seriously injured by severe attack of Texas fever as a result of tick inoculation the first summer. At least four others had the fever some

### Clinical Notes on Dumas Short-Horns.

The two Shorthorn calves, owned by Dumas, of Arlington, Ala., were inoculated only once. (see Table V). This was done in November. The following August Mr. Joel Dumas writes me stating that about ten days after the calves were inoculated the primary inoculation fever appeared and continued about two weeks, the temperature ranging from 103 to 106. The heifer's temperature was invariably higher than that of the bull calf. During the high fever the bowels were kept active by drenching the calves with raw linseed oil, and when they would not eat they were drenched with milk. After recovery they were turned into a pasture with other cattle, and "have had ticks on them all along." He says: "My Shorthorn calves have done very well, and I think now they are perfectly immune." Nov. 1., these calves were safe.

Notes on the last nine cases in Table No. V:

F. G. Matthews, of Florence, Ala., inoculated these animals, and under date of April 8, 1901, writes me as follows:

"I first measured the dose in a small two drachm graduated, allowing something over a half drachm for a dose (2 cc). Nine head of cattle were inoculated. Seven of them were Jerseys (one 6 months old, one 18 months old, four were 2 years old, and one was 4 years old); they came from Kentucky; the other two were 2 year old Herefords, and came from the St. Louis market. All of these cattle were brought to Alabama during the past winter.

"The vessels used were sterilized by placing them in cold water and bringing it up to boiling.

"On the 13th of March I drew the blood from a native scrub bull, 18 months old, defibrinated it, and immediately inoculated the Herefords.

"On the 14th of March I drew 2 ounces of blood, prepared it, and immediately inoculated T. and P.'s 2-year-old Jersey cow; a few minutes later, Sadler's 2-year-old Jersey cow; about 15 minutes later Proctor's 18-month-old Jersey heifer; about 30 minutes later Thurman's 2-year-old Jersey bull; about an hour later Cohen's 2-year-old cow (she was in wood's pasture, and had to be hunted), and about an hour later we secured Nathaniel's 4-year-old cow and 6-month-old calf and inoculated both of them. (Numbered in the order named). Cows 1 and 2 died March 25. On that day the temperature of No. 3 was 104; No. 4, 103; No. 5, 105. March 26, No. 3, 107; No. 4, 103; No. 5, 105; Nos. 6 and 7, 104. No. 3 was too weak to stand up long at a time. March 27, No. 3, 105.5; No. 4, 102.5; No. 5, 102.5; Nos. 6 and 7, 104. These temperatures remained this way for several days and then subsided. The animals suffered loss of appetite one or two days. The bull's temperature went up again in a few days to 104, and No. 3 developed a swelling under the throat and weeping at the eyes—the above conditions passed off in a few days.

"I can not understand why Nos. 1 and 2 should have died and No. 3 became so violently affected when the others took the regular or normal course. Possibly the severity of the fever in these three cases was due to the freshness of the blood at the time they were inoculated, the blood being somewhat old at the time the others were inoculated."

"Very respectfully,

"FRED G. MATTHEWS."

The time of year when these 9 head of cattle were inoculated was not altogether suitable—the weather was a little too warm. The best time of year for inoculation is from November 1st to March 1st. Moreover, some

these cattle were too old to be inoculated with safety, and the dose of defibrinated blood was too large for a single or first inoculation. The strength of the blood of an immune animal is never known until it is tested by inoculation; hence it is always safest to use the minimum dose in the beginning or the first time the blood is used. All of these animals should have been collected at one place so that there would have been no delay in the inoculations following the drawing of the blood and the defibrinating it. The vessels were not sufficiently sterilized. They should have been boiled at least for thirty minutes, and for safety one hour.

TABLE VI—SUMMARY OF NORTHERN-BRED CATTLE SHIPPED INTO ALABAMA IN THE LAST 3 YEARS  
and acclimation attempted by natural tick inoculation.

No.	Age when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama.	Died of Texas Fever	Living and acclimated.	REMARKS.
1	1 year.	bull	...	Polled Durham...	Lambert...	Wilcox	...	1	Kept away from Southern cattle.
1	8 mo's.	heifer..	...	Red Poll...	"	"	...	1	Separate from herd cattle.
1	18 mo's.	"	...	"	"	"	...	1	Allowed to run with herd
2	14 mo's.	bulls..	...	"	"	"	2	2	Well cared for and isolated.
2	18 mo's.	"	...	"	"	"	...	2	
2	3-5 yrs.	cows	...	"	"	"	1	1	
1	4 yrs.	bull ..	Tenn	"	"	"	1	1	
1	1 yr.	"	...	R. P. & S. H. Cross	"	"	...	1	Kept isolated.
1	1 yr.	"	...	Shorthorn	"	"	...	1	"
1	18 mo's.	"	...	"	"	"	...	1	
1	2 years.	"	...	Red Poll..	"	"	...	1	
1	45 days.	"	...	Devon.	"	"	1	1	
1	45 days.	"	...	"	"	"	...	1	
2	18 mo's.	heifers	...	Red Poll	"	"	...	2	
1	9 mo's.	bull	Ill.	Angus	Kernachan.	Colbert	...	2	Well cared for.
1	"	heifer	"	"	"	"	...	1	"
1	1 year.	"	Tenn.	Hereford	"	"	...	1	"
1	"	bull	Mo.	"	Swope.	"	...	1	"
5	2 yr's.	heifers.	...	"	"	La wrence.	...	1	Isolated and stabled.
1	9 mo's.	bull	Ill.	Angus	"	"	...	5	"
8	10-18 mo's.	bulls.	Penn..	Devons	Hare	Monroe	...	1	"
15	"	heifer	"	"	"	Chambers	4	11	"





TABLE VI.—Cont'd.

Summary of Northern-Bred Cattle shipped into Alabama in the last three years, and acclimation attempted by natural tick inoculation.

No.	Are when brought to Alabama.	Sex.	State where bred.	Breed.	Owner.	County in Alabama	Died of Texas Fever.	Living and acclimated	REMARKS.
10	6-12 mos 3 b, 7 h	Tenn.	Shorthorn.	F. I. Derby.	Sumter	2	8		
2	6-22 mos 1 b, 1 h	"	"	J. Sims.	"	1	1		Died second year.
1	6 mo's. heifer	"	"	Wallace	"	1			
1	1 yr. bull	"	"	Comer	Bullock		1		
1	3 yrs. bull	"	"	"	"		1		
4	4 yrs. cows	"	"	"	"	1	3		
1	4 yrs. cow	"	Jersey	Haughton	"	1	1		
1	1 yr. bull	"	Shorthorn	Foster	"	3			
3	1 yr. heifers	"	"	"	"				
1	2 yrs. heifer	"	"	"	"		1		
1	2 yrs. heifer	"	Jersey	"	"		1		
5	1 yr. 1 b, 4 h.	Miss (?)	Herefords.	Rainer	"	3	2		Ship'd Mch from Columbus, Miss.
1	7 mo's. bull	Tenn.	Shorthorns.	Culver	"		1		Shipped in October to Ala.
2	7 mo's. heifers	"	"	"	"		2		" " "
1	8 mo's. bull	"	Angus	Goldthwaite	Montgomery		1		Weight 1400 lbs, at about 80 mo's.
1	5 mo's. bull	"	Short horns	Marks.	"		1		Shipped Nov. 1899. to Ala.
2	8 mo's. 1 b, 1 h	"	"	Gunter.	"		2		
2	8 mo's. 1 b, 1 h	"	"	P. Tyson.	"		2		
4	6 mo's. 1 b, 3 h.	"	"	McLemore	"	1	3		
8	8 mo's. 1 b, 2 h	"	"	T. W. Oliver	"		8		
1	cow	"	"	Smith.	"		1		
2	1 b, 1 c.	"	Red Poll	"	"		2		
1	bull	"	Polled Durham	"	"		1		
2	"	"	Short horns	Torbert	Lee		2		

The total number of Northern-bred cattle on this list is 139. This, however, does not include all the Northern-bred animals shipped into Alabama during the past three years. There were many others brought into Alabama during the same period but we were unable to get authentic reports about them.

Of the total number reported (139), there were 31 fatal cases of fever; or 22.3 per cent. of the entire number died of Texas fever from inoculation. At the same time it should be noted that some of these cattle are still susceptible to Texas fever because they have been kept entirely free from ticks. Comparing the results (22.3 per cent. loss) with about 10 per cent. of deaths of Dr. Francis, where 1500 cattle were inoculated with defibrinated blood to produce immunity, gives a decided favorable balance for the new inoculation method. Or, compare the 22.3 per cent. loss with the 8 per cent. of deaths as shown in the summary of defibrinated blood inoculations made in Alabama.

In order to aid Alabama farmers who may desire to embark in the stock business by buying Northern-bred cattle, the veterinarian of the college and station will inoculate such animals with defibrinated blood, providing his expenses are paid to and from the place where cattle are to be inoculated. Parties desiring such inoculations will please notify the veterinarian in advance so that a date may be fixed to suit his convenience.

All farmers who have bought Northern-bred or foreign-bred cattle into Alabama at any time during the past three years will do us a great favor by reporting the results of their respective attempts at acclimating their cattle. Please give the age of each animal at time of arrival in Alabama; sex, breed, State from whence they came, how long said cattle have been in Alabama, how many are safely acclimated, with method of acclimating, and how many died with Texas or acclimating fever. If a number of animals were acclimated, the report may be tabulated as in Table VI.

We also solicit reports of all contagious or infectious diseases occurring among farm animals in Alabama. In case of serious or alarming outbreaks report directly to the veterinarian, and if possible, and best, he will at once visit the locality to determine the cause, and suggest ways of preventing and treatment.

I wish to take this opportunity to thank all those who so kindly sent in reports, and hope this bulletin will in part repay them for their trouble. I am especially thankful to Mr. R. W. Clark, who has charge of the stock at the Experiment Station, and who so carefully and faithfully looked after ten of the inoculated cattle that were directly in his care.

**REMEMBER.**

1.—That an animal sick with Texas fever can not infect or transmit the disease to healthy cattle.

2.—That the only known means by which the micro-parasite that causes Texas fever can be transmitted from diseased cattle to healthy ones is through two generations of the Southern cattle tick.

3.—That tick-free cattle never have Texas fever as long as they are tick-free.

4.—That cattle with Texas fever have or have had ticks upon them.

5.—That all cattle must acquire immunity after birth by having one or more attacks of Texas fever.

6.—That immunity to Texas fever is not inherited.

7.—That Southern-bred cattle have Texas fever when very young (sucking calves), and are usually but slightly affected by it.

8.—That the older the animal the more severe the fever; the older the animal the greater the mortality.

9.—That all cattle north of the government quarantine line are susceptible to Texas fever.

10.—That all Southern-bred cattle raised on tick-free farms and tick-free town lots are susceptible to Texas fever.

11.—That immune cattle will lose their immunity if kept free of ticks for two or more years.

12.—That in hot weather Texas fever is usually more acute and fatal than in cool seasons.

13.—That the best time to bring Northern-bred or foreign-bred cattle into Alabama is between November 1st and March 1st.

1.—That it is safer to bring young sucking calves into Alabama for acclimation than cattle over one year old.

15.—That sucking calves (2 to 4 months old,) can be shipped into the South by express; fed milk from a Southern-bred and immune cow, and be made immune by natural tick inoculation with a great degree of safety or little danger of loss.

16.—That one or two inoculations with defibrinated blood derived from an immune animal will produce a relatively safe immunity to Texas fever.

17.—That the best age for inoculating with defibrinated blood is one year or less.

18.—That the best time for the inoculation is from November 1st to March 1st.

19.—That inoculations should not be attempted in hot weather.

20.—That pregnant cows are liable to abort when they have inoculation or Texas fever.

21.—That inoculated animals should receive the best of feed and care during and after the inoculation fever.

22.—That from 50 to 90 per cent. of Northern-bred or susceptible cattle die with Texas fever when they are turned into tick-infested pastures, and allowed to rustle for themselves.

23.—That less than 10 per cent. of susceptible cattle are lost when they are made immune by the defibrinated blood inoculation method; about 3 per cent. die with the inoculation fever, and about 7 per cent. die with Texas fever as a result of tick inoculation during the first summer.

24.—That it is best to keep all cattle from becoming literally covered with ticks.

25.—That if you are adjacent to the government quarantine line it is best to exterminate all the ticks on your farm and farm animals.

DE—Parties who are interested, and who may  
a Farmers' Institute held in their town or city,  
ase write the veterinarian of the college and sta-  
ating when they desire the institute, and about  
ny farmers they can get to attend said meeting.  
nds for this work are limited, but we aim to visit  
y counties as possible with our means during the  
We can visit one or two places each month while  
is in session, and a number of counties during  
ummer vacation. Dr. C. A. Cary is Official Di-  
of Farmers' Institute for the station and college.





Sci 1623.25.4

o. 117.

DECEMBER, 1901.

ALABAMA.

# tural Experiment Station

OF THE

TURAL AND MECHANICAL COLLEGE,

AUBURN.

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## RICHARD NOTES.

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By C. F. AUSTIN.

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MONTGOMERY, ALA.

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The Bulletins of this Station will be sent free to any citizen  
the State on application to the Agricultural Experiment Station  
Auburn, Alabama.

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## ORCHARD NOTES.

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The season of 1901 was in many respects a favorable one for Alabama fruit-growers. The very mild preceeding winter had left the trees in excellent condition. Some of the earlier blooming plums escaped the frost and bore a good crop. The crop of fruit in the Experiment Station orchard was not as large as that of the preceding year; but it must be stated that the crop secured during 1900 was unusually large. The spring of 1901 was very late, wet and cold, and, therefore, prevented in many varieties a normal setting of fruit. As a result of the late spring the earlier varieties fruited from one to two weeks later than usual.

The young apple orchard planted in the years 1897 and 1900 continues to be very promising. Nearly every variety made a strong, vigorous growth during the past season. The method of treatment was the same as outlined in Bulletin 112, and has proven satisfactory. Some of the varieties planted in 1897 bore their first fruit this season.

Observations as to the prevalence of apple leaf rust (*Roestelia*) showed that the following varieties were affected:

- Aikin, slightly.
- Babbitt, slightly.
- Battyani, slightly.
- Buncomb, slightly.
- Bledsoe, slightly.
- Bradford, slightly.

Benoni, slightly.  
 Cillagos, slightly.  
 Cannon Pearmain, slightly.  
 Carolina Greening, very badly.  
 Cooper's Red, slightly.  
 Carter's Blue, very badly.  
 Chattahooche, very badly.  
 Dam, slightly.  
 Early Harvest, slightly.  
 Elgin Pippin, slightly.  
 Equinettelee, badly.  
 Family, very badly.  
 Grime's Golden, slightly.  
 Hands, slightly.  
 Homing, slightly.  
 Haygood, very badly.  
 Jeffries' Everbearing, slightly.  
 Jonathan, very badly.  
 Julian, badly.  
 Keeskemet, slightly.  
 Moultries, badly.  
 Mangum, badly.  
 Marvinia, badly.  
 Nickajack, very badly.  
 Mavarack Sweet, slightly.  
 Oszi-vaj, slightly.  
 Pear (or Palmer), slightly.  
 Red Limbertwig, slightly.  
 Rawls Janeton, slightly.  
 Red June, badly.  
 Rome Beauty, very badly.  
 Red Beitigheimer, slightly.  
 Rodes Orange, very badly.  
 Sekula, slightly.  
 Summer Wafer, slightly.

rockley, very badly.  
 enator, very badly.  
 anta, badly.  
 weet Bough, slightly.  
 nornton's Seedling, slightly.  
 aunton, slightly.  
 exas Red, slightly.  
 alalyfi, badly.  
 ellow English, slightly.  
 opp's Favorite, very badly.  
 ellow Horse, slightly.  
 ork Imperial, slightly.

The following varieties were free from rust this sea-

pple of Commerce.  
 rkansas Black.  
 uda Summer.  
 ack Ben Davis.  
 hampion.  
 ooper's Early.  
 pir.  
 anny.  
 all Pippin.  
 arvenstein.  
 yari Piros.  
 ershall Cox.  
 ew's Crab.  
 ennings.  
 ennard's Choice.  
 aggar.  
 etell.  
 ammoth Black Twig.  
 aiden Blush.  
 obble Savor.

Pasman.  
 Ponjik.  
 Red Astrachan.  
 Early Red Margaret.  
 Sabadka.  
 Summer Queen.  
 Saxon Priest.  
 Selymes.  
 Summer Cheese.  
 Shackleford.  
 Tuscaloosa Seedling.  
 Winesap.  
 Yakor.  
 Yates.

Early Red Margaret, Sabadka, Winesap, and Yakor which showed rust last year, escaped this, and, in addition to those affected last year, there are thirty-four more varieties affected this season. A greater number of the Hungarian varieties were affected this year than last year. Resistant varieties have for the past few seasons been giving a good deal of promise, but this season so many more varieties were affected than usual, that it is probable we have no varieties in our orchard that are perfectly resistant to the disease.

*Spraying to Prevent Rust.*—To determine if very thorough spraying with Bordeaux mixture would have any effect upon the rust, one tree of each variety was selected and kept very carefully sprayed from early spring until late in the fall. The Bordeaux mixture was used at the rate of six pounds of copper sulphate and six pounds fresh lime to fifty gallons of water.

The varieties selected for this spraying experiment were affected during the season of 1900 as follows:

Carter's Blue, slightly.  
 Cooper's Red, moderately.

Dam, slightly.  
 Early Red Marguerite, badly.  
 Family, very badly.  
 Hames, slightly.  
 Horse, moderately.  
 Jonathon, very badly.  
 Red June, slightly.  
 Santa, badly.  
 Senator, badly.  
 Shockley, badly.  
 Thornton's Seedling, slightly.  
 Winesap, slightly.  
 Yakor, slightly.

The trees were very carefully sprayed on the following dates during the season: March 24th, before growth started; April 25th, May 4th and 22nd, June 5th and 20th, July 23rd, August 9th and 28th.

On October 10th the trees were examined and the following notes taken showing the relative amount of rust on the sprayed trees. The trees at this time were heavily covered with the Bordeaux mixture:

Carter's Blue, badly.  
 Cooper's Red, badly.  
 Dam, slightly.  
 Early Red Marguerite, very badly.  
 Hames, slightly.  
 Horse, moderately.  
 Red June, slightly.  
 Jonathon, very badly.  
 Santa, very badly.  
 Senator, very badly.  
 Shockley, very badly.  
 Thornton's Seedling, slightly.  
 Winesap, slightly.  
 Yakor, slightly.

This seems to indicate that spraying with Bordeaux mixture has no effect upon the disease. Some of the varieties were even more affected this season than in the past. In reviewing the work of the past few seasons, it can be said that the rust is gradually increasing throughout the orchard. At present there are but few varieties that have not been at least slightly affected by the rust. While many of the varieties have not been so affected so as to show reduced growth, many of them have received a very serious setback from this cause.

*The Green Aphis of Apples.*—This insect has been very troublesome this season, and spread upon many varieties not attacked before.

The following varieties have been more or less affected:

Aikin, badly.  
 Apple of Commerce, very badly.  
 Battyani, badly.  
 Black Ben Davis, very badly.  
 Bledsoe, slightly.  
 Benoni, slightly.  
 Carolina Green, badly.  
 Cooper's Red, badly.  
 Cooper's Early, badly.  
 Early Harvest, slightly.  
 Elgin Pippin, badly.  
 Epir, very badly.  
 Family, badly.  
 Garvenstein, slightly.  
 Horse, very badly.  
 Jeffries' Everbearing, very badly.  
 Jennings, slightly.  
 Mammoth Black Twig, very badly.

Moultries, very badly.  
 Mangum, very badly.  
 Mamma, slightly.  
 Noble Savor, badly.  
 Nickajack, slightly.  
 Mavarack Sweet, slightly.  
 Os-zi-vaj, badly.  
 Pear (or Palmer), badly.  
 Red Limbertwig, badly.  
 Rawls Janeton, very badly.  
 Red Beitigheimer, very badly.  
 Red Margaret, slightly.  
 Summer Queen, very badly.  
 Saxon Priest, badly.  
 Shockley, slightly.  
 Senator, very badly.  
 Summer Cheese, slightly.  
 Sweet Bough, badly.  
 Shackleford, badly.  
 Texas Red, slightly.  
 Tuscaloosa Seedling, slightly.  
 Winesap, badly.  
 Wealthy, slightly.  
 Yellow English, badly.  
 Yakor, slightly.

This agrees to some extent with last year's report. There were sixteen varieties attacked this season that were not last, and thirteen varieties that were attacked last year that are free this. As in the case of the rust, the varieties that are resistant to the attack of the insects are becoming fewer every year. The indications are that there are no varieties that we can say are perfectly resistant to the attacks of this insect.

*List of Hardy Varieties.*—The following have been free from rust, aphid, and leaf spot for the past three



seasons: Hyari Piros, Magyur, Maiden Blush, Metell, and Ponyike. There were eight hardy varieties last year and only five this. Three of the American varieties—Aikin, Babbitt and York Imperial—were slightly attacked with rust. Of the varieties that are not in the above list, but that have made a satisfactory growth, and are in good condition this fall are the following:

Aikin.	Jennings.
Arkansas Black.	Keeskemet.
Babbitt.	Kinnard's Choice.
Battyan.	Limbertwig.
Buncomb.	Mavarack Sweet.
Bradford.	Red Astrachan.
Bledsoe.	Summer Wafer.
Carter's Blue.	Selymes.
Champion.	Yakor.
Epir.	York Imperial.
Elgin Pippin.	Wilalyfi.
Gravenstein.	

The following varieties fruited for the first time this season: Bledsoe, Champion, Red Limbertwig, Thornton's Seedling, and Whalye.

The work with the bearing orchard has been along the line of spraying with Bordeaux mixture as a preventative against summer rot\* and other diseases that cause the decay of fruit before maturity. As the first test along the line it was decided to keep the orchard very thoroughly sprayed from early spring until the fruit was ripe. The orchard was sprayed nine times

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\*We use the term summer rot to denote all the kinds of rot as a class. The one rot very noticeable this season was what is known as black rot (*Sphærospis malorum*).

during the summer at the following dates: March 27th, before growth started; April 8th and 25th, May 22nd, June 5th and 22nd, August 9th and 28th. Paris green was used, after the blossoms had fallen, at the rate of eight ounces to fifty gallons of the mixture, which was the same as that used in spraying for apple rust. Care was taken to cover the whole tree very thoroughly, and especially the fruit.

*Notes on Varieties.*—The varieties that were practically free from rot are: Early Harvest, Hames, Hews' Virginia, Hiley's Eureka, Hubersham Late, Prior's Red, Red June, Summer Red, Thornton's Seedling, Shockley, Stephens' Winter, Winesap.

Varieties only slightly affected by the rot: Ben Davis, Golden Pippin, Horn, Kellageskee, Limbertwig, Red Astrachan, Rome Beauty, Rawls' Janeton, Shannon Pippin, Terry's Winter, Yopp's Favorite.

Varieties which rotted badly: American Golden Russett, Cannon Pearmain, Elgin Pippin, Red Limbertwig, Yellow English.

The growing of apples is a very difficult problem so far South, and without spraying a greater per cent. of the apples are more or less rotten before they are ripe. The orchard was an old one, and has had very little treatment. It was full of all kinds of diseases and insects that had flourished at will.

The work of the fruit season seems to point to the conclusion that by careful selection of varieties, good cultivation, and thorough spraying, good clean apples can be grown here from June until early winter. The old trees this season have made a good, strong, healthy growth.

## CHERRIES.

In the spring of 1898 eleven of the leading varieties of cherries were planted. All of the trees of three of the varieties have died. Several more are making a struggle for existence. Four of the varieties have made good strong growth and seem to be fairly hardy in this climate. They are: Deyhouse, Governor Wood, Omer, and Suda. These varieties all bloomed full and gave promise of a heavy fruitage this season, but when the fruit was about half grown the bulk of it dropped off. Whether this peculiarity is due to the climatic conditions or to the trees not being old enough can not at present be determined.

Although cherries can not be recommended for general planting they should be in the list of the home garden for the northern half of the State.

Varieties.	No. of trees set 1898.	No. of trees alive 1901.	General condition in the fall 1901.
Abbasse.....	2	1	Fairly strong and vigorous.
Black Tartarian	2	1	Weak and growth poor.
Dyehouse .....	1	1	Vigorous and strong with a good growth.
Early Richmond	1	0	
English Morello	1	0	
Governor Wood.	2	1	Vigorous, good healthy growth.
Mont. O. King.	2	2	Fairly vigorous, growth small.
Napolean.....	1	0	
Ostheimer.....	2	2	Strong and vigorous with a good growth
Suda.....	2	2	Strong and vigorous with a good growth.
Wragg.....	2	2	Vigorous, fair growth.

### JAPAN WALNUTS.

Trees were set in 1896. They fruited for the first time this season. The nuts are of medium size, borne in large clusters, from six to twelve; shell is a little thicker than that of the English walnut, which they resemble to some extent. The meat is sweet and of good quality, the tree bears early and is a very rapid grower. It makes a handsome tree, having leaves of immense

size. It should be included in the list for home planting throughout the State.

### PEACHES.

The peach orchard has done well this season, for which the crop has not been large, nearly all varieties have borne some fruit. A coöperative experimental orchard was planted in 1898, at the request of a committee of the Association of Agricultural Colleges and Experiment Stations, for the testing of the geographical limits of the successful cultivation of the different races of peaches. The test consisted of three varieties of three trees each, of the five races of peaches. The orchard bore a good crop this season, and it is now possible to form some idea of their value.

**Alexander.**—An old standard sort. Medium, greenish white, covered with red; flesh white, firm, juicy, sweet clingstone. Season first to the middle of June; tree vigorous and productive. A leading early market sort.

**Mt. Rose.**—Medium to large, white, with red cheek; flesh quite firm, juicy, rich, sweet; freestone; a leading market variety; ripens from the first to the middle of July. Tree vigorous and usually quite productive.

**Old Mixon.**—This is another old variety. Medium to large, yellowish white, with red cheek; flesh white, very rich and juicy; freestone; a good shipper, and well known upon the market. Season from the middle to the last of July.

### PEENTO RACE.

Varieties—**PEENTO**, **WALDROW**, and **ANGEL**. The varieties of this race bloom so early that the blossoms are all killed by the frost. See table of blooming period.

## NORTH CHINA RACE.

**Chinese Cling.**—Large, globular, pale yellow; flesh very firm, sweet, rich; a close clingstone; a fine sort for pickling; season first to the middle of July. Tree vigorous and quite productive.

**Elberta.**—Large to very large, round oval, pale yellow unless fully ripe; flesh pale yellow, firm, rich, juicy, slightly acid; freestone; ripens last of July to first of August. Tree strong, vigorous and very productive. The leading market variety for the South.

**Mammie Ross.**—Large, round, white, with red cheek, and small red specks over the surface; flesh white, streaked with red under the skin; tender, juicy, sweet; clingstone; season first to the middle of July. Tree vigorous and productive. A promising new variety.

## SOUTH CHINA RACE.

**Pallas.**—Medium, roundish, greenish yellow, with some red over the surface; flesh very white, sweet, rich; freestone; a promising variety for home use and local market; season middle of July. Tree vigorous and very productive. The best variety of the race.

**Tabor.**—Medium, roundish oblong, pointed, covered with red; flesh white, sweet, juicy; clingstone. Tree vigorous and fairly productive; ripens the last of July.

**Honey.**—Small, yellowish white, oval, slightly flattened, terminating in a prominent point; flesh very white, sweet, tender, juicy; freestone; season first of July. Trees are fairly vigorous and quite productive.

## SPANISH RACE.

**Imperial.**—Medium to large, roundish oblong, greenish yellow, covered with reddish spots over the surface; flesh white, tender, juicy, sweet; freestone; season last of July. Tree vigorous and quite productive.

**Onderkonk.**—Small to medium, pale yellow, flesh yellowish, tender, juicy, good; freestone; ripens about the first of August. Tree vigorous and productive.

**Cable's Indian.**—Small, roundish, dull grayish red; flesh firm, reddish; clingstone; season first of August. Tree vigorous and productive.

Notes on the Blooming of the Races of Peaches for 1901.

Varieties.	Jan. 22.	Feb. 30.	Feb. 24.	March 4.	March 15.	March 26.	April 1.	April 6.
Alexander. . .	.....	.....	.....	PERSIAN RACE.	.....	.....	.....	.....
Mount'in Rose	.....	.....	.....	buds swollen..	first blooms.	buds showing pink	full bloom..	blossoms falling.
Old Mixon....	.....	.....	.....	buds swollen..	first blooms.	full bloom..	.....	.....
Peento. ....	buds showing pink.	blooms fallen..	.....	PEENTO RACE.	Blossoms all killed by the frost.	.....	.....	.....
Waldrow.....	.....	buds showing pink..	blooming	.....	Blossoms all killed by the frost.	.....	.....	.....
Angel.....	.....	.....	buds showing pink	full bloom..	Blossoms all killed by the frost.	.....	.....	.....
Chinese Cling.	.....	.....	.....	NORTH CHINA RACE.	all killed by the frost.	.....	.....	.....
	.....	.....	.....	buds pink..	full bloom..	blossoms falling.	.....	.....



*Notes on the Blooming of the Races of Peaches for 1901.*

Varieties.	Jan. 22.	Feb. 20.	Feb. 24	March 4.	March 15.	March 26.	April 1.	April 6.
Elberta .....	.....	.....	.....	.....	buds opening.	full bloom..	blossoms fallen.	.... ..
Mammie Ross.	.....	.....	.....	.....	buds pink.	full bloom..	blossoms falling.	.....
				SOUTH CH	INA RACE.			
Pallas.....	.....	.....	.....	.....	buds pink..	full bloom..	blossoms fallen.	.... ..
Tabor.....	.....	.....	.....	.....	buds pink..	blooming...	blossoms falling.	.....
Honey... .	.....	.....	buds pink..	buds opening..	full bloom..	blossoms falling.	.....	.....
				SPANISH	RACE.			
Imperial.....	.....	.....	.....	buds pink..	full bloom..	blossoms fallen.	.....	.....
Onderkonk. . .	.....	.....	buds swollen.	buds pink..	full bloom..	blossoms fallen.	.....	.....
Cable's Indian	.....	.....	.....	buds swollen.	blooming...	full bloom..	.....	.....

The varieties of the Peento race bloom so early that they have no value outside the orange belt. The trees of the South China and Spanish races are strong, vigorous growers, and very productive. Many varieties of these races are suitable for the southern half of the State and coast region for home use and local market. As yet neither race contains any varieties that will compete with the leading market sorts of the Persian or North China races. A variety of peaches containing the vigor and productiveness of the trees of the South China and Spanish races, with the size, color, appearance and general market qualities of the Persian and North China races would be a valuable addition to Southern peach growing.

#### NOTES ON OTHER VARIETIES OF PEACHES.

**Carmen** —Large, nearly round, white with red cheek; flesh firm, white, rich, juicy, slightly acid; nearly free; season first to middle of July. Tree vigorous and productive. A promising variety for general planting.

**Early Crawford.**—An old standard variety; large, oblong oval, rich yellow with a red cheek; flesh yellow, firm, rich, slightly acid; season middle to last of July. Tree vigorous and usually productive. Under favorable conditions this is one of the leading commercial varieties. It wants a rich heavy soil to do its best, for upon poor land it is a shy bearer.

**Grey.**—Medium to large, rather long and flattened, with a prominent point at the end; skin very smooth, pale yellow, slightly sprinkled with red; flesh thick, firm, rich, sweet; freestone. Tree vigorous and quite productive. It seems to be a promising variety.

**Hale's Early.**—Medium to large, roundish, greenish white, nearly covered with red; flesh firm, good; cling-

stone; season middle of July. Tree vigorous and productive. This is an old market sort, its great drawback is its tendency to rot at harvest time.

**Matthew's Beauty.**—Large, roundish, yellow; flesh thick, firm, rich, sweet; freestone; season middle to end of August. Tree vigorous and fairly productive. This variety follows Elberta and is a promising late sort.

**McKinney.**—Medium to large, yellowish with red cheek; flesh white, firm, juicy, sweet; clingstone; season middle to last of June. Tree a strong grower and fairly productive; a promising new variety.

**Stump.**—Medium to large, round with red cheek; flesh thick, firm, sweet, juicy; freestone; season first of August; tree strong, vigorous and productive. An old sort, but still one of the best white varieties in its season; a good keeper and shipper.

**Ovido.**—Small to medium, roundish oblong with a prominent point at the end, greenish yellow with red cheek; flesh greenish white, tender, juicy and sweet; freestone. Tree a strong grower and very productive.

**Sneed.**—Medium, roundish oval, white with red cheek; flesh greenish white, juicy; clingstone; season last of May. Tree strong, vigorous and productive. The earliest peach yet produced.

**Triumph.**—Medium, yellow, nearly covered with red; flesh yellowish; tender, juicy, good; nearly free; season first to middle of June. Tree vigorous and productive; an excellent early peach and a good shipper.

**Victoria.**—Small to medium, nearly round, pale yellow; flesh pale yellow, sweet, juicy; freestone; season first of August. Tree a good grower and quite productive.

## OF VARIETIES FOR GENERAL PLANTING IN THE STATE.

A short list including some of the best market  
we would suggest the following, given in the order  
of merit: Sneed, Triumph, Carmen, Mammie Ross,  
Main Rose, Chinese Cling, Elberta, Stump, Matthe-  
w's Beauty. For a longer list for home use and local  
trade take the above list and add to it Alexander, Mc-  
Cord, Hale's Early, Early Crawford, Grey, Pallas,  
Imperial. The last four varieties are suitable  
for the southern half of the State and coast region.

*Notes on the Blooming of Peaches.*

Varieties.	March 4.	March 15	March 26.	April 1.	April 6.
Carmen .....	buds swelling.	buds opening.	full bloom.	blossoms falling.	.....
Early Crawford ..	.....	first blooms.	full bloom.	blossoms falling.	.....
Grey .....	buds swelling.	first blooms.	full bloom.	blossoms falling.	.....
Hale's Early. ....	.....	buds pink.	first blooms.	.....	full bloom.
Marks.....	.....	buds pink.	full bloom.	.....	.....
Matthew's Beauty .....	.....	first blooms.	full bloom.	blossoms falling.	.....
McKinney. ....	.....	buds pink.	first blooms.	full bloom.	blossoms falling.
Stump.....	.....	first blooms.	full bloom.	blossoms falling.	.....
Ovido .....	buds opening.	full bloom.	blossoms fallen.	.....	.....
Reeves.....	buds swelling.	first bloom.	full bloom.	blossoms falling.	.....
Sneed.....	buds swollen	buds opening.	full bloom.	blossoms fallen.	.....
Triumph.....	.....	buds swollen.	blooming	full bloom.	blossoms fallen.
Victoria.....	.....	blooming	blossoms fallen.	.....	.....

## PLUMS.

The season has not been a very favorable one for plums. The varieties have fruited very unevenly. This is probably due to the excessive crop of 1900, which left the trees in poor condition. The hailstorm of May 13th did a considerable damage by the hailstones marking the surface of the fruit so as to give it a poor appearance. On account of the freedom from late frost this spring, we were able to get some fruit from the very early blossoming sorts. We give a table of notes on the blossoming period, and general condition of crop, and another tabulation showing the number of trees of each variety, that were set in 1896, the number of trees that have died from 1896 to the fall of 1901, and the number of trees alive at present, with a note as to their general condition.

During the present season a large number of trees have died from some unaccountable cause. For one to have a successful plum orchard, a setting of trees must be made every year. So that as fast as one orchard gives out another will be coming on to take its place. (For description of plums and varieties for planting see Bulletin No. 112.)

*Notes on the Blooming of Plums 1901.*

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Abundance, Berger, Botan and Yellow Fleshed Botan.	.....	buds showing white.	buds opening.	full bloom.	.....	.....	About one-half crop.
Burbank. ....	buds show- ing white.	buds opening.	full bloom..	fallen. ....	.....	.....	Very light.
Blood No. 4 .....	buds opening.	nearly full bloom.	blossoms falling.	.....	.....	.....	Good.
Berckman's .....	.....	buds opening.	full bloom..	falling.....	.....	.....	Light.
Chabot, Babcock, Bailey's Japan, Hattankio, Mun- son, or Yellow Japan.....	.....	buds opening.	full bloom..	fallen. ....	.....	.....	Light.
Chas. Downing...	.....	.....	buds swelling.	buds opening.	nearly full bloom.	blossoms falling.	Full.
Emerson.....	buds opening.	full bloom..	falling.....	.....	.....	.....	Full.

varieties.	March 11.	March 18.	March 25.	April 1.	April 8.	April 15.	in 1901.
Excelsior.....	.....	buds opening.	full bloom..	fallen. ....	.....	.....	Very good.
Earliest of All ...	.....	.....	buds swelling.	buds opening.	full bloom..	.....	Failure.
Golden Beauty...	.....	.....	buds swelling	buds opening.	blooming. .	blossoms falling.	Very full.
Gold.....	.....	buds opening.	blooming .	fallen. ....	.....	.....	Fair.
Hale.....	.....	buds opening.	blooming ..	fallen.. ....	.....	.....	Failure.
Hawkeye.....	.....	.....	.....	.....	buds swelling.	blooming ..	Good.
Kelsey.....	buds opening.	blooming...	falling. ....	.....	.....	.....	Light.
Kurr.....	.....	buds white.	buds opening.	falling ....	.....	.....	Very good.
Lone Star.....	.....	buds white.	full bloom..	fallen. ....	.....	.....	Failure.



*Notes on the Blooming of Plums in 1901.—Cont'd.*

Varieties.	March 4.	March 9.	March 15.	March 26.	April 6.	April 11.	Condition of crop in 1901.
Long Fruited.....	.....	.....	.....	buds opening.	full bloom..	falling. ....	Failure.
Maru .....	.....	.....	.....	buds swelling	buds opening	full bloom..	Failure.
Normand.....	.....	buds opening.	blooming...	falling.....	.....	.....	Very full.
Milton.....	.....	.....	buds opening.	blooming...	full bloom..	.....	Fair.
Orient.....	.....	buds opening.	blooming...	falling .....	.....	.....	Tree died before ripening crop.
Pres. Wilder. ....	.....	.....	buds opening.	blooming...	full bloom..	.....	Light.
Red Nagate.....	.....	.....	buds opening.	blooming ..	blossoms falling.	.....	Full.
Rockford .....	.....	.....	.....	.....	buds opening.	blooming...	Failure.
Satauma.....	buds opening.	blooming...	blossoms falling.	.....	.....	.....	Good.

*Notes on the Blooming of Plums in 1901.—Cont'd.*

Varieties	March 4.	March 9.	March 15.	March 26.	April 6	April 11.	Condition of crop in 1901.
Transparent.....	.....	buds opening.	blooming ..	blossoms falling.	.....	.....	Very full.
Willard.....	.....	.....	.....	buds opening.	blooming ..	blossoms falling.	Failure.
Wickson.....	buds opening.	blooming.	blossoms falling.	.....	.....	.....	Light
Whitaker.....	.....	.....	.....	buds opening.	blooming ..	blossoms fallen.	Good.
Wayland.....	.....	.....	buds opening	blooming.	full bloom..	blossoms fallen.	Failure.
Wooten.....	.....	.....	buds opening.	blooming ..	full bloom..	blossoms falling.	Full.
Wild Goose.....	.....	.....	buds white.	buds opening	blooming ..	blossoms fallen.	Full.
Yosebe.....	.....	.....	buds white.	buds opening.	blooming ..	blossoms falling.	Light.

*Notes on the General Condition of the Orchard.*

Varieties. JAPANESE TYPE.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Abundance, Berger, Botan, Yellow Fleshed Botan.....	8	7	1	Strong, vigorous, good growth.
Berckmans. ....	2	1	2	In good growing condition.
Burbank.....	4	2	2	Poor growth, trees dying.
Blood No. 3.....	2	0	2	
Blood No. 4.....	2	2	0	Making a good growth.
Chabot, Babcock, Baily, Hattankio, Munson, Yellow Japan.....	11	4	7	The few trees left are in good condition.
Hale.....	3	3	0	Very strong and vigorous.
Kelsey.....	2	1	1	Tree in fair condition.
Kerr.....	3	2	1	Quite strong and vigorous.
Long Fruited.....	2	0	2	
Maru.....	2	0	2	

*es on the General Condition of the Orchard.—Cont'd.*

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
and.....	2	2	0	Trees in good condition.
.....	2	0	2	
ne, Nagate ....	5	3	2	Strong and healthy trees.
na.....	2	1	1	Last tree slowly dying.
d.....	2	0	2	
e.....	1	1	0	In very good condition.
Totals... .. ERICAN TYPE.	55	29	26	
eye.....	2	0	2	
ord.... ..	2	1	1	Making a struggle to live.
r.....	2	0	2	
.	2	0	2	•
Totals..... D GOOSE TYPE.	8	1	7	.
s Downing.	2	1	1	Making good growth.

*Notes on the General Condition of the Orchard.—Cont'd.*

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
Milton.....	2	2	0	In good condition.
Miner.....	2	0	2	
President Wilder.	2	1	1	Making good, strong growth.
Whitaker.....	2	1	1	Making fair growth.
Wild Goose.....	2	1	1	Growth very poor.
Wooten.....	2	2	0	Small growth.
Totals.. WAYLAND TYPE.	14	9	6	
Golden Beauty...	2	2	0	Very strong and vigorous.
Wayland.....	2	1	1	Last tree nearly dead.
Totals.. CHICASAW TYPE.	4	3	1	
Emerson.....	2	2	0	Making a steady growth.
Lone Star.....	2	2	0	Only a fair growth.
Transparent.....	1	1	0	Vigorous growth.

*Notes on the General Condition of the Orchard.—Cont'd.*

Varieties.	Trees set 1896.	Trees alive 1901.	Died from 1896 to 1901.	General condition of trees.
<b>Totals.....</b>	5	5	0	
<b>HYBRID PLUMS</b>				
Gold.....	2	2	0	Making good, strong growth.
Excelsior.....	2	2	0	Vigorous and strong.
Wickson .....	2	1	1	Making very poor growth.



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OF

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AUBURN.

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ALABAMA.

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## COWPEA CULTURE.

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By J. F. DUGGAR.

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# THE FLORA OF THE METAMORPHIC REGION OF ALABAMA.

BY F. S. EARLE.

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The following list of the ferns and flowering plants of the Metamorphic Region of Alabama is based on the collections in the herbarium of the Alabama Polytechnic Institute at Auburn. The Alabama material in this herbarium was secured as follows: First, a few plants collected prior to 1895 by Dr. P. H. Mell and his assistants. (The bulk of this earlier material was destroyed by fire); second, a few plants collected during the Fall of 1895 by Dr. L. M. Underwood; third, plants collected during the Spring and Summer of 1896 by L. M. Underwood and F. S. Earle; fourth, plants collected during the Fall of 1896, during 1897, and the Spring and Summer of 1898 by C. F. Baker and F. S. Earle; fifth, plants collected from the Fall of 1898 to the Summer of 1901 by F. S. Earle and Mrs. F. S. Earle. Prior to 1897 attention had been devoted mainly to the fungi, flowering plants being taken only incidentally. Prof. Baker first suggested the systematic collection of the flowering plants, and the greater part of the species enumerated below were taken during the period of his residence at Auburn.

As Dr. Charles Mohr was known to be working on a flora of Alabama, the collections made prior to mid-summer of 1897 were all sent to him for determination, and he was permitted to retain a full set, including all types, for his own herbarium. These plants are frequently referred to in his recent work on *The Plant Life of Alabama* that was published first by the United States Department of Agriculture as Volume 6, of the *Con-*

tributions from the National Herbarium (issued July 31, 1901), and later (October, 1901), was reissued as a report from the Alabama Geological Survey. After midsummer of 1897 Dr. Mohr became so occupied in the preparation of the manuscript for this great work that at his request the sending of plants was discontinued, except as he occasionally asked for material in some special group. The later collections have been determined by Dr. J. K. Small, Mr. G. V. Nash, Dr. Edward L. Greene and other specialists, and by the writer, who has recently had an opportunity to compare some of the more doubtful material with the rich collections in the herbarium of the New York Botanical Garden. Some fifty species are reported by Dr. Mohr of our collecting that are not represented in the herbarium of the Polytechnic Institute; or at least are not represented under the name by which Dr. Mohr reports them. These species are included in this list, Dr. Mohr being cited in each case as the authority. These specimens will be found either in the herbarium of Alabama plants deposited by Dr. Mohr at the State University at Tuscaloosa, or in his private herbarium, which is now incorporated with the National Herbarium at Washington. In part, at least, these species represent uniques that did not chance to be again collected by us. There are, however, too many to be wholly accounted for in this way, and it seems probable that some of them represent cases where Dr. Mohr found occasion to change his original determination of the specimens. It has not been possible to trace these cases, for since the publication of Dr. Mohr's work I have not had access to the collections. It has seemed best to include these names, but with this word of warning as to the possibility of error through including two determinations for the same plant.

It so chanced that Dr. Mohr did very little collecting in that part of the State covered by this list. He, however, made one visit to the rugged mountainous region in Clay county and secured a number of plants that were not taken by us. A few plants have also from time to time been collected in this region by various members of the State Geological Survey. Fifty-two plants from these sources are recorded by Dr. Mohr from this region that do not appear in our collections. These are included in this list, the proper credit being given. It is probable that the specimens representing them are all in the herbarium at Tuscaloosa.

The Metamorphic region of Alabama as mapped by the State Geological Survey, is a triangular area lying on the eastern side of the State. It extends from near the southeast corner of Lee county at a point nearly opposite Columbus, Ga., northerly along the State line for about a hundred miles to a point in the northern part of Cleborne county. From this point the second side of the triangle extends southwestwardly for about the same distance, to a point in Chilton county, some three miles east of the line of the Louisville & Nashville railroad, and from here another hundred miles east-southeast to the point of beginning. This area comprises the southernmost extension of the Appalachian mountain system. It is underlaid by granite and other metamorphic rocks which exert their usual influence on the topography, giving high, rugged hills and frequent exposures of bare rock. There are, however, few vertical or overhanging cliffs, such as are frequent to the north and west in the region underlaid by the coal measures. The soil varies from a light and rather coarse sandy loam to the red hornblendic soil so characteristic of the Piedmont region of Georgia. In many places it is much incumbered with angular fragment of quartz and other hard resistant



rocks. The original timber growth varied from almost pure long leaf pine forests at the southern border and along the bluffs of the Tallapoosa, to pure hardwood forests on the richer areas, especially to the northward. The greater part of the area was, however, a mixed forest of hardwoods and long or short leaf pines. The region is divided into nearly equal parts by the Tallapoosa river, the portion to the south and east being the high, broad ridge that forms the divide between this stream and the Chattahoochee. The northwestern portion forming the divide between the Tallapoosa and the Coosa is more rugged and broken, and in the Talladega Mountains reaches the highest elevations to be found in the State (2,300 feet). This is one of the most interesting parts of the State, and deserves much more extended study. It was visited only once by Dr. Mohr and once by the writer.

This metamorphic region is of special interest botanically since it constitutes the southernmost extension of the Carolina Life Zone. Many of the characteristic plants of the Appalachian system find here their most southerly stations while mingling with these northern representatives are many plants that have pushed up from the Gulf region. This mingling of the two floras accounts for the large number of species found. Of the 1146 species and varieties enumerated in the following list, 94 are new to the State, and are not included in Dr. Mohr's work. These are indicated by an asterisk (\*). There are 76 others that were previously known in Alabama only from the northern part of the State. These represent an extension of the known range in the State to the southward, and are marked by a dagger (†). There are also 167 species that represent a northerly extension of the known range within the State. These are indicated by a double dagger (‡). The larger number

This latter class is accounted for by the fact that Auburn, where the greater part of the collecting was done, is on the extreme southern border of the metamorphic zone. In fact the more sandy lands of the central pine belt extend at one point to within half a mile of the college building. All the plants collected in the neighborhood of Auburn have been included in the list whether they were taken from one side or the other of this rather vaguely defined line. While most of the plants that are marked with the double dagger are undoubtedly characteristic of the central pine belt rather than of the metamorphic hills; still it is probable that most or quite all of them are to be found at some point on the more sandy lands that are clearly within this region proper.

The ecological relations of the flora have not in all cases been critically studied. The topographical features of the country will, of course, limit the plant societies and formations. The following situations have each a more or less clearly marked flora, and the brief notes on habitat following each species in the list, in most cases, indicate the nature of the locality where the plant should be sought. Beginning with the cryptophytes we may distinguish, first, the plants of the rapidly moving streams with which the region is abundantly supplied. Second, plants of pools and ponds. Ponds are not frequent, those found being mostly artificial. Third, marsh plants, inhabiting certain open miry places, and the open boggy banks of streams. Such plants are restricted and rather infrequent, but certain plants are found only in such localities. Fourth, swamp plants of the poorly drained timbered land along streams. In clay land there are likely to be "alder swamps," the prevailing growth being alder (*Alnus ru-*

gosa) and willow (*Salix nigra*) frequently with a dense undergrowth of cane (*Arundinaria tecta*). In sandy land swamps are more often "bay heads" with a prevailing growth of white bay (*Magnolia Virginiana*), red bay (*Persea pubescens*) and maple (*Acer rubrum*.) In places these "bay heads" develop into "Sphagnum bogs," where the ground is carpeted with peat moss (*Sphagnum* sp.). Each of these varieties of swamp has its own peculiar association of plants. Of mesophyte associations we have, 1st, the plants of the better drained creek and river bottoms, and, 2nd, the moister and richer northern slopes of the uplands. Such locations are usually heavily timbered mostly with hard woods, but occasionally mixed with loblolly pine (*Pinus laeda*) in the lowlands, and with the short leaf pine (*Pinus echinata*) in the uplands. These associations are rich in the number of species and include most of the more northern types. The plants from the Gulf region are to be sought on the dryer, more sandy uplands, and in the sandy bay heads and Sphagnum bogs. More or less distinctly zerophytic associations occupy the greater part of the upland area. Here we may distinguish. 1st, plants of the dry hardwood forests. These are usually found on the south slopes of the red clay hills; 2nd, plants of mixed woods, including long or short leaf pines and hard woods. This type of forest is the prevailing one over a large part of the entire region; 3rd, plants of the long leaf pine (*Pinus palustris*) forests. These are confined to the extreme southern border and to a strip along the hills bordering the Tallapoosa river. A large number of southern species are found in this long leaf pine association; 4th, an extremely zerophytic association found on exposed granite outcrops. Occasionally granite outcrops occur where they are somewhat moisted

by a stream or spring and here we find still a different association of plants. Besides these which may be considered as constituting the natural plant covering of the region we have other associations whose advent is determined by the presence of man. Among these we may distinguish, 1st, the weeds of cultivated fields and gardens; 2nd, the weeds of pastures, roadsides and waste places; 3rd, the plants of abandoned or "turned out" fields, and, 4th, the plants of the second growth woods that ultimately reclothe these abandoned fields. The loblolly pine (*Pinus Taeda*) usually plays the leading part in this forestization, though with it are associated sweet gum (*Liquidambar*) black gum (*Nyssa sylvatica*), persimmon (*Diospyros*) and occasional individuals of numerous other trees.

#### OPHIOGLOSSACEAE.

*Botrychium biternatum* (Lam.) Underw.

A single specimen, upland pasture, Auburn, (in Underwood Herbarium.)

*Botrychium obliquum* Muhl.

Frequent, creek-bottom woods.

*Botrychium Virginianum* (L.) Sw.

Occasional, creek-bottom woods.

*Ophioglossum crotalophoroides* Walt.

Occasional, grassy creek-bottom pastures.

#### OSMUNDACEAE.

*Osmunda cinnamomea* L.

Common, swampy places.

*Osmunda regalis* L.

Common, swamps.

## POLYPODIACEAE.

- † *Adiantum pedatum* L.  
Moist, shaded hillsides, river hills, Tallapoosa county.
- Asplenium Bradleyi*, D. C. Eaton.  
Clay county (Mohr's Plant Life.)
- Asplenium Filix-foemina* (L.) Bernh.  
Common, moist woods, variable.
- Asplenium parvulum* Mart. & Gall.  
Clay county (Mohr's Plant Life.)
- Asplenium platyneuron* (L.) Oakes.  
Common, rocky hillsides, granite outcrops.
- Asplenium Irichomanes* L.  
Clay county (Mohr's Plant Life.)
- Cheilanthes lanosa* (Michx.) Watt.  
Common, cliffs, granite outcrops.
- Dryopteris Floridana* (Hook.) O. Kuntze.  
A single station, a swamp 6 miles south of Auburn, Lee co.
- Dryopteris marginalis* (L.) A. Gray.  
Clay county (Mohr's Plant Life.)
- † *Dryopteris Noveboracensis* (L.) A. Gray.  
Clay county, creek bottoms.
- † *Dryopteris Thelypteris* (L.) A. Gray.  
Occasional, creek bottoms, moist rich woods.
- † *Onoclea sensibilis* L.  
Occasional, creek bottoms, clay land.
- † *Phegopteris hexagonoptera* (Michx.) Fee.  
Occasional, moist woods, creek bottoms.
- Polypodium polypodioides* (L.) A. S. Hitchcock.  
Common, rocks, tree trunks.
- Polystichum acrostichoides* (Michx.) Schott.  
Common, rocky hillsides in woods.
- † *Pteridium aquilinum pseudocaudatum* Clute.  
Common, dry pine woods.
- † *Woodsia obtusa* (Spreng.) Torr.  
Frequent, rocky banks, granite outcrops.
- Woodwardia areolata* (L.) Moore.  
Common, creek bottom swamps.

*Woodwardia Virginica* (L.) Smith.

A single collection, Auburn.

#### LYCOPODIACEAE.

*Lycopodium pinnatum* (Chapm.) Lloyd & Underw.

Frequent, sphagnum bogs.

#### SELAGINELLACEAE.

*Selaginella apus* (L.) Spring.

Frequent, on the ground in swamps.

#### PINACEAE.

*Pinus Virginiana* L.

Frequent, especially along roadsides.

*Pinus echinata* Mill.

The short leaf pine; common in mixed upland woods.

*Pinus palustris* Mill.

The long leaf pine; the prevailing timber on sandy lands,  
Lee county, and on dry rocky ridges bordering the Tallapoosa River.

*Pinus Taeda* L.

Loblolly pine, old field pine, swamp pine; common, swamps  
and uplands, especially as a second growth in abandoned  
fields.

#### TYPHACEAE.

*Typha latifolia* L.

Frequent, marshy places and shallow ponds and ditches.

#### SPARGANIACEAE.

*Sparganium angustifolium* (Engelm.) Morong.

Occasional, marshy places.

#### ALISMACEAE.

*Sagittaria latifolia* Willd.

Common, marshes and ditches.

‡*Sagittaria pubescens* Muhl.

A single collection, swamp in river hills, Elmore county.

POACEAE.

*Agrostis Elliottiana* Schult.

Common, dry open places.

*Agrostis hyemalis* (Walt.) B. S. P.

Common, dry open places.

‡*Agrostis intermedia* Scribn.

A single collection, Auburn.

*Aira caryophylla* L.

Common, dry open places.

*Alopecurus geniculatus* L.

Occasional, wet open places.

*Andropogon argyraeus* Schultes.

Common, dry woods and fields.

\**Andropogon corymbosus* (Chapm.) Nash.

Occasional, wet swampy places.

‡*Andropogon Elliottii* Chapm.

Occasional, dry woods.

*Andropogon furcatus* Muhl.

Infrequent, dry woods and roadsides.

‡*Andropogon glomeratus* (Walt.) B. S. P.

Frequent, wet swampy places. A smaller form with  
panicles occurs in moist, upland woods.

*Andropogon scoparius* Michx.

Very common and variable. As here recognized it pro-  
bably includes more than one species.

*Andropogon Tracyi* Nash.

Frequent, sandy uplands fields or thin woods.

*Andropogon Virginicus* L.

Very common, especially in old fields. (Broom sedge). V.

‡*Anthaenatia villosa* Beauv.

Occasional, moist sandy lands, south of Auburn.

*Aristida lanosa* Muhl.

Frequent, dry sandy lands, south of Auburn.

*Aristida purpurascens* Poir.

A single collection, Auburn.

*Phenatherum elatius* (L.) Beauv.

A single collection, Auburn.

*Arundinaria tecta* (Walt.) Muhl.

Common, creek bottom swamps (Cane.)

*Eleusine indica* (Willd.) H. B. K.

Occasional, fields, roadsides, etc. (escaped.)

*Brachyelytrum erectum* (Schreb.) Beauv.

Occasional, rich upland woods.

*Eleusine aromaticus* (Walt.) Scrib.

Gold Hill, Lee county (Mohr's Plant Life.)

*Tripsacum dactylon* (L.) O. Kuntze.

Abundantly introduced (Bermuda grass.)

*Eleusine echinatus* L.

Occasional, sandy fields.

*Eleusine glauca* (L.) Scribn.

Common, cultivated fields.

*Eleusine perennis* (Curtiss) Bicknell.

A single collection, Auburn.

*Eleusine avenaceus* (Michx.) Benth.

Common, upland woods and open places.

*Eleusine nutans* (L.) Benth.

Common, upland woods and open places.

*Eleusine arundinacea* L.

Occasional, wet swampy places.

*Eleusine Aegyptium* (L.) Willd.

Common, cultivated fields.

*Eleusine sericea* Nutt.

Frequent, dry woods and open places, clay or sand.

*Eleusine spicata* (L.) Beauv.

Rocky hillsides, clay land, north of Auburn.

*Eleusine filiformis* (Chapm.) Vasey.

Frequent, dry woods.

*Eleusine nitida* (Spreng.) Nash.

Common, dry woods.

*Eleusine Pennsylvanica* (D C.) A. Gray.

Dry open hillsides, Auburn.

*Eleusine Pennsylvanica* (D C.) A. Gray.

A single collection, Auburn, creek bottom woods.



- Echinochloa Crus-galli (L.) Beauv.**  
Occasional, gardens and barnyards.
- Eleusine Indica (L.) Gaertn.**  
Common, cultivated fields.
- \*Elymus galbriflorus (Vasey) Scribn. & Ball.**  
Occasional, dry woods.
- Elymus strictus Willd.**  
Lee county, Earle & Baker (Mohr's Plant Life.)
- Elymus Virginicus L.**  
Lee County, (Mohrs Plant Life.)
- †Eragrostis hirsuta (Michx.) Nash.**  
Frequent, dry, open places.
- Eragrostis major (L.) Host.**  
Common, cultivated fields.
- Eragrostis pectinacea (Michx.) Steud.**  
Common, dry open places.
- Eragrostis Purshii Schrad.**  
Occasional, cultivated fields.
- †Eragrostis refracta (Muhl.) Scribn.**  
Common, dry open places.
- Erianthus alopecuroides (L.) Ell.**  
Common, upland woods, usually on clay.
- \*Erianthus compactus Nash.**  
Common, upland woods, usually on clay.
- \*Erianthus contortus Ell.**  
Common, poor usually sandy woods.
- Festuca nutans Willd.**  
Frequent, moist woods.
- \*Festuca obtusa Spreng.**  
A single collection, Chambers county.
- Festuca octoflora Walt.**  
Common, dry open places.
- Festuca octoflora aristata (Torr.) Dewey.**  
Lee county, Earle & Baker (Mohr's Plant Life.)
- Festuca sciurea Nutt.**  
Lee county, Earle & Baker (Mohr's Plant Life.)
- Festuca Shortii Knuth.**  
Lee county, Earle & Baker (Mohr's Plant Life.)

*Gymnopogon ambiguus* (Michx.) B. S. P.

Frequent, dry sandy woods.

*Homalocenchrus Virginicus* (Willd.) Britt.

Frequent, wet swampy places.

*Panicum nervata* (Willd.) O. Kuntze.

Occasional, cultivated fields.

*Panicum mutica* Wall.

Frequent, upland woods.

*Muhlenbergia capillaris* (Lam.) Trin.

Frequent, dry open places.

*Muhlenbergia diffusa* Schreb.

A single collection, Auburn.

*Panicum hirtellus* (L.) R. & S.

Occasional, moist sandy places in shade.

*Panicum nervata* (Willd.) O. Kuntze.

Common, wet shady places.

*Panicum agrostoides* Muhl.

Clay county (Mohr's Plant Life.)

*Panicum Alabamense* Ashe.

Collected once, Auburn, swamp. This is very close to *P.*

*lucidum* Ashe, and is probably identical with that species.

*Panicum angustifolium* Ell.

Very common, dry upland woods and roadsides.

*Panicum Auburne* Ashe.

Collected once, Auburn, uplands. This is probably only a small form of *P. sphaerocarpon*. Ell.

*Panicum barbulatum* Michx.

Common, wet, swampy woods.

*Panicum Rogueanum* Ashe.

Collected once, Auburn, uplands.

*Panicum clandestinum* L.

Occasional, alder swamps, clay land.

*Panicum commutatum* Schult.

Common, dry sandy uplands, roadsides, old fields and thin woods; often forming a dense sod.

*Panicum depauperatum* Muhl.

Common, dry uplands.

**Panicum dichotomum L.**

Very common, moist or dry land.

**Panicum Earlei Nash.**

Occasional, sandy swamps.

**Panicum elongatum Pursh.**

Occasional, damp places.

**\*Panicum hians Ell.**

Frequent, low, wet places.

**Panicum lanuginosum Ell.**

Collected once, Chambers county.

**‡Panicum laxiflorum Lam.**

Very common, moist places. A form has been called *P. carolinianum* Scribn.

**Panicum lucidum Ashe.**

Frequent, wet places, sphagnum bogs, etc.

**Panicum melicarium Michx.**

Lee county, Earle & Baker (Mohr's Plant Life.)

**Panicum microcarpon Muhl.**

Frequent, moist uplands.

**\*Panicum mutabile Scribn. & Merrill.**

Occasional, dry woods. These specimens have been determined as *P. Joori* Vasey.

**Panicum neuranthum Greiseb.**

Collected once, Auburn.

**Panicum oliganthos Schult.**

Occasional, sandy uplands.

**Panicum Porterianum Nash.**

Common, rich uplands.

**Panicum pseudopubescens Nash.**

Very common, dry uplands.

**‡Panicum pubifolium Nash.**

Frequent, sandy uplands.

**Panicum pyriforme Nash.**

Lee county, Earle & Baker (Mohr's Plant Life.)

**Panicum Ravenelii Scribn. & Merrill.**

Frequent, sandy uplands.

**Panicum rostratum Muhl.**

Common, uplands.

*Panicum scoparium* Lam.

Common, open sandy creek bottoms.

†*Panicum Scribnerianum* Nash.

Collected once, Auburn.

*Panicum sphaerocarpon* Ell.

Frequent, ditch banks and uplands.

*Panicum Texanum* Buckl.

Common, fields, introduced.

*Panicum trifolium* Nash.

Frequent, swamps.

†*Panicum verrucosum* Muhl.

Common, shaded swamps.

*Panicum virgatum* L.

Common and variable, uplands and creek bottoms.

†*Panicum Webberianum* Nash.

Common, dry exposed uplands, clay or sand.

\**Panicum Yadkinensis* Ashe.

Collected once, creek bottom, Auburn.

\**Paspalum augustifolium* Le Conte.

Frequent, upland woods, often confused with *P. laeve*. Michx.

*Paspalum Boscianum* Fleugge.

Common, cultivated fields.

*Paspalum ciliatifolium* Michx.

Common, upland woods.

*Paspalum compressum* (Sw.) Nees.

Common, wet pastures (Carpet grass.)

†*Paspalum dilatatum* Poir.

Frequent, wet pastures and roadsides.

†*Paspalum distichum* L.

Occasional, wet-creek bottoms.

†*Paspalum Floridanum* Michx.

Occasional, sandy uplands.

*Paspalum laeve* Michx.

Occasional, upland woods.

†*Paspalum longipedunculatum* Le Conte.

Occasional, sandy uplands.

*Poa annua* L.

Common, dooryards, pastures and waste places.

- Poa autumnalis* Muhl.  
Frequent, swampy woods.
- †*Poa pratensis* L.  
Occasional, roadsides and open woods.
- ‡*Sorghum Halapense* (L.) Pers.  
Frequent, fields and waste places, (Johnson grass.)
- Sporobolus asper* (Michx.) Kunth.  
Frequent, sandy woods and roadsides.
- Sporobolus Indicus* (L.) R. Br.  
Common, pastures and door-yards, (Smut grass.)
- Sporobolus punceus* (Michx.) Kunth.  
Frequent, dry sandy woods south of Auburn.
- Stipa avenacea* L.  
Frequent, upland woods, sand or clay.
- ‡*Syntherisma fimbriatum* (Link) Nash.  
Common, cultivated fields, (Crab grass.)
- ‡*Syntherisma villosum* Walt.  
Occasional, cultivated fields.
- Tricuspis seslerioides* (Michx.) Torr.  
Common, upland woods and open places.
- Tripsacum dactyloides* L.  
Frequent, ditch banks and borders of moist fields.
- \**Trisetum aristatum* (Scribn. & Merrill) Nash.  
Dry clay woods, Tallapoosa county.
- ‡*Trisetum Pennsylvanicum* (L.) Beauv.  
Frequent, moist woods.
- Uniola latifolia* Michx.  
Frequent, rich upland woods.
- Uniola laxa* (L.) B. S. P.  
Collected once, Auburn.
- Uniola longifolia* Scribn.  
Frequent, upland woods and creek bottoms.

## CYPERACEAE.

- Carex Atlantica* Bailey.  
Frequent, rich woods.
- Carex cephalophora* Muhl.  
Frequent, dry wooded hillsides.

*Carex crinita* Lam.

A single collection, Auburn.

*Carex debilis* Michx.

Frequent, wet woods.

*Carex granularis* Muhl.

Lee county, Earle & Baker (Mohr's Plant Life.)

*Carex gynandra* Schw.

Occasional, upland woods, Lee county, Tallapoosa county.

*Carex interior* Bailey.

Lee county, Earle & Baker (Mohr's Plant Life.)

*Carex intumescens* Rudge.

Frequent, swamps and ditch banks.

*Carex laxiflora* Lam.

Common, upland woods.

*Carex laxiflora varians* Bailey.

Lee county, Earle & Baker (Mohr's Plant Life.)

*Carex leptalea* Wahl.

Common, swamps.

*Carex lurida* Wahl.

Frequent, swamps and marshy places.

*Carex nigro-marginata* Schw.

Frequent, dry rocky hillsides and granite outcrops. The most southerly known station for this rare *Carex*.

*Carex oblita* Steud.

Frequent, swamps.

*Carex ptychocarpa* Steud.

Frequent, creek bottom swamps.

*Carex sterilis* Willd.

Frequent, swampy creek bottoms.

*Carex stipata* Muhl.

Frequent, wet open places.

*Carex tenera* Dewey.

Common, rich woods.

*Carex Texensis* (Torr.) Bailey.

Occasional, Auburn.

*Carex triceps* Michx.

Common dry upland woods.

- Carex verrucosa* Muhl.  
Frequent, swamps, matures in midsummer. (=C. glaucescens Ell. of Mohr's Plant Life.)
- Carex vulpinoidea* Michx.  
Common, wet places, ditch banks, etc.
- Cyperus cylindricus* (Ell.) Britt.  
Frequent, sandy fields, etc.
- Cyperus echinatus* (Ell.) Wood.  
Common, sandy uplands.
- Cyperus filiculmis* Vahl.  
Frequent, sandy lands.
- Cyperus Haspan* L.  
Frequent, marshy grass lands.
- Cyperus Lancastriensis* Porter.  
Occasional, Lee county, Tallapoosa county.
- Cyperus ovularis* (Michx.) Torr.  
Frequent, dry uplands.
- Cyperus pseudovegetus* Steud.  
Frequent, swampy places.
- Cyperus retrofractus* (L.) Torr.  
Common, dry sandy uplands.
- Cyperus rotundus* L.  
Nut grass, a garden pest, locally abundant.
- Cyperus stenolepis* Torr.  
Lee County, Earle & Baker. (Mohr, Plant Life.)
- Cyperus strigosus* L.  
Common, fields and marshy places.
- Eleocharis obtusa* Schultes.  
Common, marshy places.
- Eleocharis prolifera* Torr.  
Occasional, marshy places.
- Eleocharis tuberculosa* (Michx.) R. & S.  
Occasional, marshy places.
- Fimbristylis autumnalis* (L.) R. & S.  
Common, marshy places and sandy fields.
- \**Fimbristylis laxa* Vahl.  
A single collection, Auburn.

- \**Fuirena squarrosa* Michx.  
Common, marshy places.
- †*Fuirena squarrosa hispida* (Ell.) Chapm.  
Frequent, sphagnum swamps, etc.
- †*Hemicarpha micrantha* (Vahl) Britt.  
Frequent, marshy places.
- Kyllinga pumila* Michx.  
Common, wet places.
- Rhynchospora axillaris* (Lam.) Britt.  
Occasional, marshy places.
- †*Rhynchospora corniculata* (Lam.) A. Gray.  
Frequent, borders of ponds, etc.
- Rhynchospora cymosa* Ell.  
Frequent, marshy places.
- Rhynchospora filifolia* Torr.  
A single collection, Auburn.
- Rhynchospora glomerata* (L.) Vahl.  
Occasional, marshy places.
- Rhynchospora glomerata paniculata* (A. Gray) Chapm.  
Common, moist or dry open places, roadsides, etc.
- \**Rhynchospora microcephala* Britt.  
A single collection, Auburn.
- \**Rhynchospora patula* A. Gray.  
A single collection, Macon's Mill, Lee county.
- Rhynchospora rariflora* Ell.  
Occasional, marshy places.
- †*Scirpus Eriophorum* Michx.  
Occasional, wet places, clay land.
- Scleria ciliata* Michx.  
Frequent, upland woods.
- Scleria oligantha* Michx.  
Frequent, upland woods.
- \**Scleria pauciflora* Muhl.  
A single collection, Auburn.
- †*Scleria pauciflora glabra* Chapm.  
Frequent, moist woods.
- Scleria triglomerata* Michx.  
Frequent, upland woods.



*Stenophyllus capillaris* (L.) Britt.

Frequent, sandy fields and marshy places.

#### PALMACEAE.

*Rhapidophyllum hystrix* (Fraser) Wendl. & Drude.

Rare, swamps, Lee county, clay and sand.

†*Sabal Adansonii* Guerns.

Rare, swamps, Lee count, in sand.

#### ARACEAE.

*Arisaema quinatum* (Nutt.) Schott.

Occasional, swamps and wet woods.

*Arisaema triphyllum* (L.) Torr.

Occasional, wet woods.

*Orontium aquaticum* L.

Clay county (Mohr's Plant Life.)

*Peltandra Virginica* (L.) Kunth.

Occasional, swamps and wet woods.

#### MAYACAEAE.

†*Mayaca Aubletii* Michx.

Frequent, sandy swamps, usually with sphagnum.

#### XYRIDACEAE.

†*Xyris ambigua* Beyrich.

A single collection, Auburn.

*Xyris Caroliniana* Walt.

Frequent, sandy borders of ponds, etc.

*Xyris communis* Kunth.

Lee county, J. D. Smith (Mohr, Plant Life.)

*Xyris flexuosa* Muhl.

Occasional, sandy swamps.

*Xyris iridifolia* Chapm.

Occasional, sandy swamps.

*Xyris torta* Smith.

Frequent, sandy swamps.

## BROMELIACEAE.

‡*Tillandsia usneoides* L.

Occasional on trees in creek bottoms. All killed by the "freeze" of February, 1899.

## COMMELINACEAE.

*Commelina communis* L.

Escaped, ditch banks, Auburn.

*Commelina erecta* L.

Frequent, dry hillsides.

*Commelina hirtella* Vahl.

Frequent, swampy creek bottoms.

‡*Tradescantia hirsuticaulis* Small.

River hills, Elmore county; also sandy woods, Lee county.

*Tradescantia montana* Shuttlw.

Rich upland woods, Clay county, Coosa county.

*Tradescantia reflexa* Raf.

Frequent, dry rocky hillsides, granite outcrops.

## JUNCACEAE.

*Juncoides echinatum* Small .

Frequent, wooded hillsides.

*Juncus acuminatus* Michx.

Frequent, wet open places.

*Juncus acuminatus debilis* (A. Gray) Engelm.

Frequent, wet open places.

*Juncus Canadensis* A. Gray.

Occasional, Auburn.

‡*Juncus diffusissimus* Buckl.

Shallow pool in swamp, Auburn.

\**Juncus Dudleyi* Wiegand.

Frequent, dry woods and roadsides.

*Juncus effusus* L.

Frequent, wet, open places.

*Juncus marginatus* Rostk.

Frequent, wet, open places.

**Juncus marginatus aristulatus** (Michx.) Coville.

Common, wet open places.

‡**Juncus polycephalus** Michx.

Frequent, wet, open places.

‡**Juncus repens** Michx.

Sandy borders of ponds, in or out of water.

\***Juncus robustus** (Englm.) Coville.

A single collection, Auburn.

‡**Juncus scripoides** Lam.

Common, wet open places.

**Juncus setaceus** Rostk.

Common, wet open places.

**Juncus tenuis** Willd.

Common, especially along paths and woods roads.

**Juncus Torreyi** Coville.

Lee county, Earle & Baker (Mohr, Plant Life.)

**Juncus trigonocarpus** Steud.

A single collection, Auburn.

#### LILIACEAE.

‡**Aletris farinosa** L.

Occasional, borders of sandy swamps.

**Allium mutabile** Michx.

Common, creek bottoms, clay land, often in fields.

**Allium veneale** L.

Introduced, fields, etc., Auburn.

\***Chamaelirium obovale** Small.

Occasional, rich upland woods.

**Chrosperma muscaetoxicum** (Walt.) O. Kuntze.

Rare, taken once near Auburn.

**Lilium Carolinianum** Michx.

Occasional, rich upland woods.

**Medeola Virginica** L.

Occasional, moist, rich woods.

**Melanthium Virginianum** L.

Rare, taken once near Auburn.

**Nothoscordium bivalve** (L.) Britt.

(= **Allium stratum**.)

Common, dry rocky hillsides, granite outcrops, etc.

**Polygonatum biflorum (Walt.) Ell.**

Frequent, moist rich woods and creek bottoms.

**†Polygonatum commutatum (R. & S.) Dietr.**

Occasional, moist, rich woods, creek bottoms, etc.

**\*Triantha glutinosa (Michx.) Baker.**(=*Tofeldia glutinosa* Michx.)

Occasional, open marshy places.

**Trillium stylosum Nutt.**

Frequent, rich, moist woods, uplands or creek bottoms, usually on clay

**Trillium Underwoodii Small.**

Common, wooded creek bottoms, clay land north of Auburn, the type locality. A taller form with less conspicuously mottled shorter leaves occurs in sandy swamps south of Auburn.

**Uvularia perfoliata L.**

Frequent, rich, moist woods, uplands or creek bottoms.

**Uvularia sessilifolia L.**

Frequent, rich, moist woods, creek bottoms, etc.

**Vagnera racemosa (L.) Morong.**

Frequent, rich, moist woods, creek bottoms, etc.

**Yucca filamentosa L.**

Occasional, roadsides and waste places.

**SMILACACEAE.****Smilax Bona-nox L.**

Occasional, fence rows and thickets.

**\*Smilax cinnamomifolia Small.**

In dry woods and old fields.

**Smilax ecirrhata (Engelm.) Wats.**

Frequent, rich upland woods.

**Smilax glauca Walt.**

Upland woods and old fields.

**†Smilax herbacea L.**

Frequent, rich woods.

**Smilax hispida Muhl.**

Frequent, thickets, etc.

**‡Smilax lanceolata L.**

Frequent, moist thickets. (Jackson vine.)

‡*Smilax laurifolia* L.

Common, swamps (Bamboo vine.)

*Smilax Pseudo-China* L.

Occasional, fence rows and thickets.

*Smilax pumila* Walt.

Frequent, dry hillsides.

*Smilax rotundifolia* L.

Common, fence rows and thickets.

‡*Smilax Walteri* Pursh.

Occasional, swamps, sandy land.

## AMARYLLIDACEAE.

‡*Atamosco Atamosco* (L.) Greene.

Common, creek bottoms.

*Hymenocallis occidentalis* Kunth.

Rare, sandy creek bottoms.

*Hypoxis hirsuta* (L.) Coville.

Common, upland woods.

*Manfreda Virginica* (L.) Salisb.(=*Agave Virginica* L.)

Frequent, dry rocky hillsides and granite outcrops.

## DIOSCOREACEAE.

*Dioscorea villosa* L.

Common, a climbing vine in rich woods.

## IRIDACEAE.

*Gemmingia Chinensis* (L.) O. Kuntze.

Occasional, roadsides, etc.

‡*Iris cristata* Ait.

Long-leaf pine woods, Tallapoosa county.

‡*Iris verna* L.

Long leaf pine woods, Tallapoosa county.

*Sisyrinchium Carolinianum* Bicknell.

Frequent, upland woods.

\**Sisyrinchium flaccidum* Bicknell.

Occasional, banks of streams.

‡*Sisyrinchium grammoides* Bicknell.

Frequent, upland woods.

#### BURMANNIACEAE.

‡*Burmannia biflora* L.

A single collection, swampy creek bottoms, sandy land.

#### ORCHIDACEAE.

*Achroanthes unifolia* (Michx.) Raf.

Rare, creek bottom swamps.

†*Corallorhiza odontorhiza* (Willd.) Nutt.

A single collection, Auburn.

*Cypripedium parviflorum* Salisb.

Clay county (Mohr's Plant Life).

*Gyrostachys cernua* (L.) O. Kuntze.

Frequent, moist places, creek bottoms, etc.

*Gyrostachys gracilis* (Bigel.) O. Kuntze.

Common, dry pine woods.

\**Gyrostachys simplex* (A. Gray) O. Kuntze.

A single collection, Auburn, dry pine woods.

\**Gyrostachys vernalis* (Engelm.) Small.

Occasional, pine woods.

*Habenaria ciliaris* (L.) R. Br.

Frequent, creek bottom woods, usually sand.

*Habenaria clavellata* (Michx.) Spreng.

Frequent, creek bottom woods, clay or sand.

*Habenaria cristata* (Michx.) R. Br.

Frequent, creek bottoms, sandy land.

*Habenaria flava* (L.) A. Gray.

Lee county, Underwood & Earle (Mohr's Plant Life.)

*Habenaria lacera* (Michx.) R. Br.

A single collection, Auburn.

†*Habenaria quinquiseta* (Michx.) Mohr.

(= *H. Michauxii* Nutt.)

A single collection, Auburn.

**Hexalectris aphyllus (Nutt.) Raf.**

Occasional, wooded hillsides, Lee county, Clay county, Elmore county.

**Leptorchis lilifolia (L.) O. Kuntze.**

Rare, creek bottom swamps.

**Leptorchis Loeselii (L.) MacM.**

Rare, creek bottom swamps, clay.

**Limodorum tuberosum L.**

Occasional, swamps, sphagnum bogs, etc., sand.

**\*Listera australis Lindl.**

A single specimen, sandy swamp, south of Auburn.

**Pogonia ophioglossoides (L.) Ker.**

Frequent, sphagnum bogs, etc.

**Tipularia unifolia (Muhl.) B. S. P.**

Occasional, moist woods, Lee county, Elmore county.

**SAURURACEAE.****Saururus cernuus L.**

Frequent, swamps.

**JUGLANDACEAE.****Hicoria alba (L.) Britt.**

Occasional, uplands.

**Hicoria glabra (Mill.) Britt.**

Common, dry upland woods, clay or sand.

**Juglans nigra L.**

Occasional, rich woods, usually clay.

**MYRICACEAE.****‡Myrica cerifera L.**

Occasional, sandy swamps.

**SALICEAE.****Populus deltoides Marsh.**

Occasional, creek and river bottoms.

**Salix nigra Marsh.**

Common, alder swamps, etc.

## BETULACEAE.

- rugosa* (Du Roi) Koch.  
 very common in wet, swampy creek bottoms, the characteristic  
 growth in such locations.
- lenta* L.  
 Clay county (Mohr's Plant Life).
- nigra* L.  
 frequent along streams, clay land.
- Caroliniana* Walt.  
 frequent, creek bottoms.
- Virginiana* (Mill.) Willd.  
 frequent, creek bottoms.

## FAGACEAE.

- dentata* (Marsh.) Borkh.  
 rare near Auburn, frequent further north, Chambers county,  
 Tallapoosa county, etc.
- pumila* (L.) Mill.  
 frequent, dry thickets.
- rostrata* Ait.  
 Clay county, Tallapoosa county, Randolph county (Mohr's  
 Plant Life). It does not occur near Auburn.
- Americana* Sweet.  
 common, moist woods, usually creek bottoms.
- acuminata* (Michx.) Sargent.  
 in high hills, Clay county; not seen about Auburn.
- alba* L.  
 frequent, rich upland woods, clay land.
- brevifolia* (Lam.) Sargent.  
 occasional, dry white sands south of Auburn.
- coccinea* Wang.  
 occasional, clay uplands, more abundant northward.
- digitata* (Marsh.) Sudw.  
 very common, uplands, sand or clay.
- Margaretta* Ashe.  
 common, white sandy soils south of Auburn, but strictly con-  
 fined to such locations. Very distinct from *Q. minor*, with  
 which it has been confused.



**Quercus Marylandica Muench.**(=*Q. nigra* of authors.) (Black jack.)

Very common, dry, sandy uplands, also on clay.

**Quercus minor (Marsh.) Sargent.**

Very common, dry uplands, sand or clay.

**Quercus Phellos L.**

Common, creek bottoms.

**\*Quercus prinoides Willd.**

Occasional, creek bottoms.

**†Quercus rubra L.**

Occasional, moist clay uplands.

**Quercus Schneckii Britton.**

Common, uplands, clay or sand.

(=*D. Texana* Sargent, not Buckl.)**Quercus velutina Lam.**

Occasional, clay uplands, frequent in upper counties.

**ULMACEAE.****\*Celtis Georgiana Small.**

Common, dry woods, fence rows, etc., a shrub.

**Celtis occidentalis L.**

Clay county (Mohr's Plant Life).

**Ulmus alata Michx.**

Common, dry uplands.

**Ulmus Americana L.**

Occasional, moist woods, creek bottoms.

**MORACEAE.****Morus rubra L.**

Occasional, rich woods, thickets.

**URTICACEAE.****Adicea pumila (L.) Raf.**

Occasional, swamps.

**Boehmeria cylindrica (L.) Willd.**

Occasional, swamps.

**Urticastrum divaricatum (L.) O. Kuntze.**

A single collection, Clay county.

## LORANTHACEAE.

*Hamamelis virginica* (Pursh) Nutt.

Frequent, usually on oaks.

## SANTALACEAE.

*Santalum umbellulata* Raf.

(= *Darbya umbellulata* A. Gray.)

A single station, creek bank, 3 miles northwest of Auburn.

## ARISTOLOCHIACEAE.

*Aristolochia Nashii* Kearney.

Occasional, moist, rocky banks.

*Aristolochia Serpentaria* L.

Occasional, moist rocky banks.

*Hexastylis arifolium* (Michx.) Small.

(= *Asarum arifolium* Michx.)

Common; rich upland woods.

*Hexastylis Ruthii* (Ashe) Small.

Occasional, rich woods. (Specimen in Herb. N. Y. Bot. Gard.)

*Hexastylis Shuttleworthii* (J. Britt.) Small.

Frequent, borders of sphagnum swamps.

## POLYGONACEAE.

*Brunnichia cirrhosa* Banks.

A single collection, Tallapoosa county, river bank

*Polygonum Convolvulus* L.

Single collection, Opelika, on the railroad.

*Polygonum Hydropiper* L.

Occasional, wet places, Lee county, Clay county.

*Polygonum Opelousanum* Riddell.

Common, moist fields, ditch banks, etc.

*Polygonum Pennsylvanicum* L.

Common, moist cultivated fields, etc.

*Polygonum punctatum* Ell.

Common, swamps and wet fields, often growing in standing water.

**Polygonum sagittatum L.**

Frequent, moist places, ditch banks.

**Polygonum setaceum Baldw.**

Common, swamps.

**Polygonum Virginianum L.**

Occasional, swampy woods.

**Rumex Acetocella L.**

Infrequent, pastures and waste places.

**Rumex crispus L.**

Common, roadsides and waste places.

**‡Rumex hastatulus Muhl.**Very common, fields and waste places. A characteristic grow  
in abandoned fields.**Rumex obtusifolius L.**

Occasional, fields and waste places.

**‡Rumex pulcher L.**

Streets of Auburn.

**CHENOPODIACEAE.****Chenopodium album L.**

Frequent, a weed in gardens and rich fields.

**Chenopodium anthelminticum L.**

Occasional, a weed in waste places.

**AMARANTHACEAE.****Amaranthus hybridus paniculatus (L.) U. & B.**

Common, a weed in gardens and rich fields.

**Amaranthus spinosus L.**

Frequent, a weed in gardens and rich fields.

**PHYTOLACCACEAE.****Phytolacca decandra L.**

Common, rich fence rows and waste places.

**NYCTAGINACEAE.****‡Boerhaavia erecta L.**

Frequent, a weed in gardens and waste places.

## AIZOACEAE.

*Portulaca verticellata* L.

Common, a weed in gardens and fields.

## PORTULACACEAE.

*Portulaca virginica* L.

One locality, wet, swampy woods 6 miles south of Auburn.

*Portulaca oleracea* L.

Occasional, a weed in rich gardens, not found in poor fields.

*Portulaca teretifolia* Pursh.

Locally common, dry granite outcrops.

## CARYOPHYLLACEAE.

*Portulaca media* L.

Common, a winter weed in gardens and waste places.

*Portulaca pubera* (Michx.) Britton.

Rich wood, river hills Tallapoosa county.

*Portulaca dichotoma* Michx.

Way county (Mohr's Plant Life).

*Portulaca brevifolia* Nutt.

Locally common, granite outcrops.

*Portulaca brachypodum* (Engelm.) Robinson.

Occasional, fields.

*Portulaca longipedunculatum* Muhl.

Occasional, fields.

*Portulaca viscosum* L.

Common, gardens, fields and waste places.

*Portulaca vulgatum* L.

Common, gardens, fields and waste places.

*Portulaca decumbens* (Ell.) T. & G.

Common, fields and gardens.

*Portulaca officinalis* L.

Occasional, roadsides, introduced.

*Portulaca antirrhina* L.

Occasional, fields and waste places.

*Portulaca stellata* (L.) Ait.

Occasional, rich woods, rocky banks of streams.

**Silene Virginica L.**

Frequent, rich upland woods, clay.

**†Spergula arvensis L.**

A single collection, Auburn (1894).

**NYMPHAEACEAE.****Brasenia purpurea (Michx.) Casp.**

In pond south of Auburn (Vaughn's Mill).

**Nymphaea advena Soland.**

Frequent, ponds and slow streams.

**MAGNOLIACEAE.****‡Illicium Floridanum Ell.**

Occasional, banks of streams, Lee county, south of Auburn.

**·Liriodendron Tulipifera L.**

Frequent, moist hillsides and creek bottoms.

**Magnolia macrophylla Michx.**

Frequent, river hills, Tallapoosa county, Clay county.

**Magnolia Virginiana L.**

Common, sandy swamps.

**ANONAECAE.****Asimina parviflora (Michx.) Dunal.**

Frequent, dry or moist places.

**Asimina triloba (L.) Dunal.**

Banks of Tallapoosa river, Elmore county.

**RANUNCULACEAE.****Actaea alba (L.) Mill.**

Lee county, Baker &amp; Earle (Mohr's Plant Life).

**†Anemone Caroliniana Walt.**

Rare, rocky hillsides (Wright's Mill.)

**Anemone quinquefolia L.**

Frequent, moist wooded hillsides.

**Anemone Virginiana L.**

A single collection, Chambers county.

†*Clematis crispa* L.

Occasional, sandy swamps.

\**Clematis glaucophylla* Small.

Occasional, dry banks, Tallapoosa county, Elmore county. The leaves are less glaucous than in the type and the achenes are narrower.

†*Clematis reticulata* Walt.

Rocky banks, Tallapoosa river, Elmore county.

*Clematis Virginiana* L.

Frequent, swamps, clay land.

*Delphinium Carolinianum* Walt.

Occasional, dry wooded hillsides.

†*Hepatica Hepatica* (L.) Karst.

Occasional, rich wooded hillsides.

*Ranunculus abortivus* L.

Frequent, fields and waste places.

*Ranunculus hispidus* Michx.

Frequent, moist or dry woods.

†*Ranunculus parviflorus* L.

Occasional, wet, swampy places.

*Ranunculus pusillus* Poir.

Occasional, wet, swampy places.

*Ranunculus pusillus Lindheimeri* A. Gray.

Frequent, wet swampy places.

*Ranunculus recurvatus* Poir.

Occasional, creek bottom woods.

*Ranunculus tener* Mohr.

Lee county, Baker & Earle (Mohr's Plant Life).

†*Syndesmon thalictroides* (L.) Hoffmg.

Frequent, moist wooded hillsides.

*Thalictrum clavatum* D. C.

Clay county (Mohr's Plant Life).

*Thalictrum purpurascens* L.

Swampy places, Chambers county, Tallapoosa county.

†*Trautvetteria Carolinensis* (Walt.) Vail.

A single collection, shaded spring branch, river hills, Elmore county.

*Xanthorrhiza apiifolia* L. Her.

Frequent, along streams, often on rocky banks.

## BERBERIDACEAE.

†*Caulophyllum thalictroides* (L.) Michx.

One locality, 3 miles northwest of Auburn. Moist, wooded hillside.

*Podophyllum peltatum* L.

Occasional, creek bottoms.

## MENISPERMACEAE.

*Calycocarpum Lyoni* (Pursh) Nutt.

Rare, creek bottoms.

*Cebatha Carolina* (L.) Britt.

Frequent, thickets, becoming a troublesome weed in cultivated fields.

## CALYCANTHACEAE.

‡*Butneria florida* (L.) Kearney.

Frequent, moist, rich woods (Mohr's Plant Life credit *Butneria fertilis* to Lee county, but this seems to be an error.)

## LAURACEAE.

‡*Persea pubescens* (Pursh) Sargent.

Frequent, swamps, usually sand.

*Sassafras Sassafras* (L.) Karst.

Occasional, mixed woods and cultivated fields.

## PAPAVERACEAE.

*Sanguinaria Canadensis* L.

Occasional, rich woods.

## CRUCIFERAE.

†*Arabis Canadensis* L.

Occasional, rocky/creek banks, granite outcrops.

*Arabis Virginica* (L.) Trelease.

Very common, a winter weed in cultivated fields.

\**Brassica juncea* (L.) Cosson.

Streets of Auburn, introduced.

*Draba Bursa-pastoris* (L.) Britt.

Common, fields and waste places.

*Draba bulbosa* (Schreb.) B. S. P.

Occasional, swampy woods, Lee county, Tallapoosa county.

*Draba Pennsylvanica* Muhl.

Occasional, rocky hillsides, granite outcrops.

*Draba didymus* (L.) J. E. Smith.

Common, upland fields and gardens.

*Draba brachycarpa* Nutt.

Common, upland fields, granite outcrops.

*Draba verna* L.

Common, upland fields (*Draba Carolina* is credited to Lee county in Mohr's Plant Life. This is an error, as the species is clearly *D. verna*.)

*Draba Virginicum* L.

Common, a weed in fields and gardens.

#### CAPPARIDACEAE.

*Draba trachysperma* T. & G.

Tallapoosa county (Mohr's Plant Life).

#### DROSERACEAE.

*Draba brevifolia* Pursh.

Frequent, borders of sphagnum bogs.

#### PODOSTEMACEAE.

*Draba ceratophyllum* Michx.

Lee county, Baker & Earle (Mohr's Plant Life).

#### CRASSULACEAE.

*Draba pusilla* (Michx.) Nutt.

Locally abundant, granite outcrops.

#### PENTHORACEAE.

*Penthorum sedoides* L.

Occasional, swamps.



## SAIXFRAGACEAE.

†*Heuchera Americana* L.

Frequent, dry rocky hillsides, granite outcrops.

*Heuchera hispida* Pursh.

Metamorphic hills, Talledega county (Mohr's Plant Life).

*Parnassia asarifolia* Vent.

Clay county (Mohr's Plant Life.)

*Philadelphus grandiflorus* Willd.

Lee county Underwood & Earle (Mohr's Plant Life). Very rare, seen only once.

†*Saxifraga Virginiensis* Michx.

Rare, in rock crevices, a single locality two miles northwest of Auburn.

*Tiarella cordifolia* L.

Occasional, moist, rocky woods, near springs.

## HYDRANGEACEAE.

*Decumaria barbata* L.

Frequent, a high climbing vine in moist woods.

*Hydrangea arborescens* L.

Occasional, moist woods and rocky banks.

*Hydrangea arborescens cordata* (Pursh) T. & G.

Clay county (Mohr's Plant Life).

*Hydrangea quercifolia* Bartr.

Frequent, moist or dry woods.

## ITEACEAE.

*Itea Virginica* L.

Frequent, sandy swamps.

## HAMAMELIDACEAE.

*Hamamelis Virginiana* L.

Frequent, moist woods.

*Liquidambar Stryaciflua* L.

Common, a tree in mixed woods, both swamps and uplands, also in old fields and second growth timber.

## PLATANACEAE.

*Platanus occidentalis* L.

Occasional, a large tree in creek bottoms.

## ROSACEAE.

†*Agrimonia mollis* (T. & G.) Britt.

Common, moist woods.

*Agrimonia parviflora* Soland.

Moist woods, Clay county. Not seen at Auburn.

‡*Agrimonia pumila* Muhl.

Frequent, sandy creek bottoms.

‡*Agrimonia striata* Michx.

Occasional, moist woods, Lee county, Clay county, Coosa county.

†*Amelanchier Botryapium* (L.) D C.

Occasional, creek banks and borders of swamps.

\**Amygdalus Persica* L.

Freely escaped, roadsides, old fields and second growth woods.  
(Peach.)

*Aronia arbutifolia* (L. f.) Ell.

Common, swamps.

†*Aruncus Aruncus* (L.) Karst.

Rare, moist woods, Auburn.

‡*Cotoneaster Pyracantha* (L.) Spach.

Sparingly escaped, roadsides, Auburn.

*Crataegus apiifolia* (Marsh.) Michx.

Occasional, creek bottoms.

*Crataegus collina* Chapm.

Common, dry woods, usually sand.

*Crataegus punctata* Jacq.

Lee county, Baker & Earle (Mohr's Plant Life).

\**Crataegus rubescens* Ashe.

Frequent, dry woods, Auburn—the type locality.

*Crataegus spathulata* Michx.

Common, upland woods and granite outcrops.

*Crataegus uniflora* Moench.

Frequent, dry woods, sand or clay.

‡*Duchesnea Indica* (Andr.) Focke.

Common, creek bottoms.

*Fragaria Virginiana* L.

Common, dry open woods, usually on clay.

†*Geum Canadense* Jacq.

A single collection, Clay county.

*Malus augustifolia* (Ait.) Michx.

Frequent, along streams.

*Opulaster opulifolius* (L.) O. Kuntze.

Locally abundant, creek bottoms, Wright's Mill.

*Porteranthus stipulatus* (L.) Britt.

A single collection, Tallapoosa county.

*Potentilla Canadensis* L.

Frequent, dry banks and open woods.

\**Potentilla humilis* Poir.

A single collection, river hills, Tallapoosa county.

*Prunus Americana* Marsh.

Clay county (Mohr's Plant Life).

*Prunus augustifolia* Marsh.

Very common, old fields, roadsides (Old field plum.)

*Prunus Caroliniana* (Mill.) Ait.

Planted as an ornamental tree and sparingly escaped  
("mock orange.")

*Prunus gracilis* Engelm.

Lee county, Baker & Earle (Mohr's Plant Life).

‡*Prunus hortulana* Bailey.

Frequent, rich clay woods, upland or creek bottoms. A large  
tree with loose, shelling bark.

*Prunus injucunda* Small.

Common, dry land, sand or clay. A small tree with close  
dark bark. (Southern sloe.)

*Prunus serotina* Ehrh.

Frequent, rich woods, clay or sand.

*Prunus serotina neo-montana* Sudw.

Clay county (Mohr's Plant Life).

*Rosa humilis* Marsh.

Common, dry woods and roadsides.

‡*Rosa laevigata* Michx.

Occasional, roadsides, introduced.

*rubiginosa* L.

Roadsides, Chambers county, introduced.

*argutus* Link.

Very common, creek bottoms, also uplands. Exceedingly variable, the common high bush blackberry.

*argutus floridus* (Tratt.) Bailey.

Occasional, dry uplands.

*cuneifolius* Pursh.

Very common, sandy uplands, the "old field" blackberry.

*Enslenii* Tratt.

Frequent, pine and mixed woods in shade.

*invisus* Bailey.

Frequent, rich woods and open places (dewberry).

*trivialis* Michx.

Common, roadsides and fields, evergreen dewberry. (Mohr's Plant Life credits *Rubus hispidus* to Lee county. This is certainly a mistake. The specimens so determined being forms of *R. trivialis*.)

#### MIMOSACEAE.

*Leucaena julibrissin* Durazz.

Abundantly escaped, roadsides and woods. A good sized tree.

*Leucaena augustata* (T. & G.) Britt.

Common, dry sandy woods.

#### CESALPINACEAE.

*Albizia Marylandica* L.

Occasional, fields and roadsides, Clay county.

*Albizia occidentalis* L.

Very common, a weed in cultivated fields.

*Albizia Tora* L.

Very common, a weed in cultivated fields.

*Albizia Canadensis* L.

Occasional, rich woods.

*Albizia naeacrista multipinnata* (Pollard) Greene.

Common, moist or dryish woods and thickets.

*Albizia naeacrista nictitans* (L.) Moench?

A single doubtful specimen, Clay county. ,

**Chamaecrista robusta** Pollard.

Common, moist woods and thickets, creek bottoms.

**Gleditsia triacanthos** L.

Occasional, rich woods.

**PAPILIONACEAE.****Amorpha fruticosa** L.

Banks of Tallapoosa, Elmore county.

**Amorpha virgata** Small.

Clay county (Mohr's Plant Life).

**Apios Apios** (L.) MacM.

Occasional, rich woods and thickets, usually clay.

**Baptisia megacarpa** Chapm.

Tallapoosa county (Mohr's Plant Life).

‡**Bradburya Virginiana** (L.) O. Kuntze.

Frequent, thickets, etc. usually sand.

**Chrysaspis dubia** (Sibth.) Greene.

Occasional, roadsides and waste places.

†**Chrysaspis procumbens** (L.) Desv.

Occasional, roadsides and waste places.

**Clitoria Mariana** L.

Common, dry woods.

**Cracca spicata** (Walt.) O. Kuntze.

Common, dry woods.

**Cracca Virginiana** L.

Common, dry woods.

‡**Crotalaria Purshii** D. C.

A single collection, dry pine woods, Auburn.

**Crotalaria rotundifolia** (Walt.) Poir.

Frequent, dry woods and open places.

**Crotalaria sagittalis** L.

Occasional, dry woods and open places.

**Dolicholus erectus** (Walt.) Vail.

Frequent, dry pine or mixed woods.

†**Dolicholus simplicifolius** (Walt.) Vail.

Frequent, sandy pine woods.

†**Dolicholus tormentosus** (L.) Vail.

Occasional, sandy pine woods.

*Falcata Pitcheri* (T. & G.) O. Kuntze.

Cleburne county (Mohr's Plant Life.)

*Galactea volubilis* (L.) Britt.

Common, dry woods and thickets.

*Lespedeza capitata* Michx.

Occasional, sandy open woods.

*Lespedeza frutescens* (L.) Britt.

Common, dry open woods.

*Lespedeza hirta* (L.) Ell.

Common, dry open woods.

*Lespedeza Nuttallii* Darl.

A single collection, Auburn.

*Lespedeza procumbens* Michx.

Common, dry open woods.

*Lespedeza repens* (L.) Bart.

Common, dry open woods.

*Lespedeza striata* (Thunb.) H. & A.

Common, old fields, roadsides and waste places (Japan clover).

*Lespedeza Stuvei* Nutt.

Common, dry open woods.

*Lespedeza Virginica* (L.) Britt.

Common, dry open woods.

*Medicago Arabica* All.

Sparingly introduced, fields and roadsides (Bur clover.)

*Meibomia arenicola* Vail.

Frequent, dry sandy or rocky woods.

*Meibomia Dillenii* (Darl.) O. Kuntze.

Common, fields and open woods.

*Meibomia grandiflora* (Walt.) O. Kuntze.

Rich woods, Coosa county. Not seen at Auburn.

*Meibomia laevigata* (Nutt.) O. Kuntze.

Common, rich shady woods.

*Meibomia Marylandica* (L.) O. Kuntze.

Occasional, moist woods.

*Meibomia Michauxii* Vail.

Frequent, dry woods, usually on rocky hillsides.

*Meibomia nudiflora* (L.) O. Kuntze.

Occasional, moist rich woods, usually clay.

*Meibomia obtusa* (Muhl.) Vail.

Frequent, dry sandy woods.

*Meibomia paniculata* (L.) O. Kuntze.

Common, moist to dry woods.

\**Meibomia paniculata* Chapmani Britt.

Frequent, moist to dry woods.

\**Meibomia paniculata* pubens (T. & G.) Vail.

Occasional, dry woods.

†*Meibomia rhombifolia* (Ell.) Vail.

Frequent, dry woods.

*Meibomia rigida* (Ell.) O. Kuntze.

Occasional, dry woods.

‡*Meibomia stricta* (Pursh) O. Kuntze.

Occasional, sandy woods and roadsides.

‡*Meibomia viridiflora* (L.) O. Kuntze.

Occasional, pine or mixed woods.

*Melilotus alba* Desv.

Sparingly introduced, roadsides.

*Phaseolus polystachyus* (L.) B. S. P.

Occasional, rich woods.

*Psoralea pedunculata* (Mill.) Vail.

Common, pine or mixed woods.

*Robinia hispida* L.

Clay county (Mohr's Plant Life).

*Robinia Pseudacacia* L. ?

Rare, a shrub in dry woods (Wright's Mill).

‡*Sesban macrocarpa* Muhl.

Introduced, an occasional weed in sandy fields.

*Strophostyles umbellata* (Muhl.) Britton.

Frequent, dry open places.

*Stylosanthes biflora* (L.) B. S. P.

Frequent, dry woods and open places.

*Stylosanthes riparia* Kearney.

Frequent, woods and banks.

‡*Trifolium Carolinianum* Michx.

Common, roadsides and grassy places.

*Trifolium pratense* L.

Sparingly introduced, streets of Auburn.

*Trifolium reflexum* L.

Occasional, dry woods, often in rocky places.

*Trifolium repens* L.

Springingly introduced, streets and roadsides.

*Vicia Hugerii* Small.

Frequent, rich mixed woods. (*V. micrantha* Nutt in credited to Lee county, Mohr's Plant Life. This is an error, the plant being a narrow leaved form of *V. Hugerii*.)

*Vicia sativa* L.

Introduced, streets of Auburn.

GERANIACEAE.

*Geranium Caroliniaum* L.

Common, fields and waste places.

*Geranium maculatum* L.

Occasional, swampy woods.

OXALIDACEAE.

*Oxalis recurva* Ell.

Very common, dry pine and mixed woods, (*Oxalis cymosa* and *O. grandis* are both credited to Lee county, Mohr's Plant Life. Probably in each case this is an error.)

*Oxalis stricta* L.

Very common, fields and waste places.

*Oxalis violacea* L.

Common, dry open woods and rocky hillsides.

LINACEAE.

*Linum Floridanum* (Planch.) Trelease.

Occasional, open sandy places.

*Linum striatum* Walt.

Occasional, moist woods, usually clay.

RUTACEAE.

*Ptelea trifoliata* L.

Occasional, river banks, Tallapoosa county, Clay county.



## SIMAROUBACEAE.

*Ailanthus glandulosa* Desf.

Occasional, roadsides, etc., introduced.

## MELIACEAE.

‡*Melia Azederach* L.

Abundant, roadsides, fence rows and old fields, introduced.

## POLYGALACEAE.

*Polygala ambigua* Nutt.

Frequent, dry woods, Clay county, Tallapoosa county.

*Polygala Boykini* Nutt.

A single collection, Clay county. (Not Lee county, as stated in Mohr's Plant Life.)

*Polygala cruciata* L.

Occasional, sandy swamps.

*Polygala Curtissii* A. Gray.

Occasional, pine woods, Lee county, Clay county.

‡*Polygala grandiflora* Walt.

Frequent, dry pine and mixed woods.

*Polygala incarnata* L.

Occasional, dry pine and mixed woods.

*Polygala Mariana* Mill.

A single collection, Auburn.

‡*Polygala nana* (Michx.) D C.

Occasional, sandy land south of Auburn.

*Polygala Nuttallii* T. & G.

A single collection, Auburn.

*Polygala polygama* Walt.

Frequent, rich woods, usually clay.

*Polygala verticillata* L.

A single collection, Auburn. (S. M. Tracy.)

## EUPHORBIACEAE.

*Acalypha gracilens* A. Gray.

Common, dry woods.

‡*Acalypha ostryaefolia* Riddell.

Occasional, fields and gardens.

*Acalypha Virginica* L.

One collection, Clay county, one Lee county.

*Croton glandulosus septentrionalis* Muell. Arg.

Occasional, roadsides and waste places.

*Croton Texensis* (Klotsch.) Muell. Agr.

Tallapoosa county (Mohr's Plant Life.)

*Crotonopsis linearis* Michx.

Frequent, dry roadsides and granite outcrops.

*\*Euphorbia apocynifolia* Small.

Common, moist woods.

*Euphorbia corollata* L.

Common, dry woods.

*\*Euphorbia corollata paniculata* Ell.

Common, dry woods.

*Euphorbia maculata* L.

Common, dry fields and waste places.

*\*Euphorbia olivacea* Small.

Occasional, dry woods.

*Euphorbia Preslii* Guss.

Common, cultivated fields.

*†Jatropha stimulosa* Michx.

Frequent, dry open woods, usually sand.

*†Stillingia ligustrina* Michx.

Banks of Tallapoosa river, Tallapoosa county.

*†Stillingia sylvatica* L.

Common, dry sandy land.

*Tragia nepetaefolia* Cav.

Frequent, rocky turned out fields.

*†Tragia urens* L.

Occasional, dry open places.

## CALLITRICACEAE.

*Callitriche Austini* Engelm.

Frequent, bare ground in old fields.

*Callitriche heterophylla* Pursh.

Frequent, floating in running water.

## ANACARDIACEAE.

**Rhus aromatica** Ait.

Clay county (Mohr's Plant Life).

**Rhus copallina** L.

Common and variable, poor to rich soil, clay, or sand.

**Rhus glabra** L.

Frequent, rich woods and thickets.

**Rhus radicans** L.

Common, a high climbing vine, (poison ivy, poison oak).

**Rhus Toxicodendron** L.

Frequent, dry rocky or sandy hills, a low shrub.

**Rhus vernix** L.

Frequent, sandy swamps, (Thunderwood).

## CYRILLACEAE.

‡**Cyrilla racemiflora** L.

Frequent, creek bottom swamps, sand or clay.

## AQUIFOLIACEAE.

\***Ilex Beadlei** Ashe.

Occasional, dry sand hills, south of Auburn.

**Hex decidua** Walt.

Occasional, moist thickets.

‡**Ilex glabra** (L.) A. Gray. 1.

Frequent, sandy swamps.

‡**Ilex glabra** (L.) A. Gray. 2.

Occasional, banks of streams, clay land.

**Ilex opaca** Ait.

Common, moist to dry woods, usually sand.

**Ilex monticola mollis** (A. Gray) Britt.

A single collection, south of Auburn, sandy swamp.

## CELASTRACEAE.

**Euonymus Americanus** L.

Frequent, moist thickets.

1. Mohr's Plant Life, 604, credits *Ilex coreacea* (Pursh) Chapm. to Lee county. This seems to be an error. The specimens cited prove to be a broad leaved form of *I. glabra*.

## ACERACEAE.

*Acer floridanum* (Chapm.) Pax.

Occasional, moist creek banks (Wright's Mill).

*Acer leucoderme* Small.

Frequent, moist rocky banks, etc., not in swamps.

*Acer negundo* L.

Local, Wright's Mill. Lee county.

*Acer rubrum* L.

Common, swamps.

*Acer saccharum barbatum* (Michx.) Trelease.

Clay county (Mohr's Plant Life).

## HIPPOCASTANACEAE.

*Euscalyptus parviflora* Walt.

Occasional, northern edge of Lee county and northward, clay.

*Euscalyptus pavia* L.

Common. dry woods.

## BALSAMMACEAE.

*Gomphocarpus biflora* Walt.

Frequent, swamps. clay land.

## SAPPINDACEAE.

*Simarouba hallebrandii* L.

Clay county (Mohr's Plant Life).

## RHAMNACEAE.

*Rhamnus scandens* (Hill) Trelease.

Frequent, moist thickets.

*Rhamnus americanus* L.

Common, dry woods.

*Rhamnus caroliniana* Walt.

Clay county (Mohr's Plant Life).

*Rhamnus arborea* (L.) Rusby.

Occasional, south of Auburn (Wright's Mill).

*Rhamnus quinquefolia* (L.) Planch.

Frequent, moist woods and thickets.

**Vitis aestivalis Michx.**

Frequent, dry or moist woods.

**Vitis bicolor LeConte.**

Clay county (Mohr's Plant Life).

**Vitis cordifolia Michx.**

Frequent, uplands, usually clay.

**Vitis rotundifolia Michx.**

Common, moist woods, creek bottoms, etc.

**TILIACEAE.****Tilia heterophylla Vent.**

Occasional, creek banks.

**MALVACEAE.****Malvastrum angustum A. Gray.**

Tallapoosa county (Mohr's Plant Life).

**‡Modiola Caroliniana (L.) Don.**

Frequent, roadsides and waste places.

**‡Sida Elliottii T. & G.**

Frequent roadsides, Tallassee; also Lee county, sandy land.

**Sida spinosa L.**

Common, gardens and cultivated fields.

**HYPERICACEAE.****‡Ascyrum hypericoides L.**

Occasional, dry woods.

**Ascyrum multicaule Michx.**

Frequent, dry woods.

**Ascyrum stans Michx.**

Occasional, dry woods.

**Hypericum Drummondii (Grev. & Hook.) T. & G.**

Common, dry open places, roadsides, old fields, etc.

**Hypericum maculatum Walt.**

Frequent, rich woods.

**Hypericum mutilum L.**

Common, ditch banks, open moist places.

*n nudiflorum Michx.*

*e collection, Auburn.*

*n virgatum Lam.*

*nal, creek banks, Lee county, Clay county.*

*entianoides L.*

*n, dry open places, roadsides, old fields, etc.*

*n petiolatum (Walt.) Britt.*

*e collection, Tallapoosa county.*

*n Virginicum (L.) Raf.*

*e collection, sandy land south of Auburn.*

### CISTACEAE.

*mum Carolinianum Michx.*

*nal, dry open places, sandy land.*

*gettii Britt. & Hollick.*

*at, sandy lands.*

*emulosa Michx.*

*nal, dry open places.*

*osa Ell.*

*n, dry open places, roadsides, old fields etc.,*

### VIOLACEAE.

*oncolor (Forst.) Raf.*

*oods, Clay county.*

*oliniana Greene.*

*n, sandy woods and open grassy places.*

*ullata Ait.*

*e collection, river hills, Tallapoosa county.*

*icaulis (T. & G.) Britt.*

*nal, moist upland woods, clay.*

*ata dilatata Ell.*

*at, rich upland woods.*

*ionacea Pursh.*

*n, creek bottoms and moist ditch banks.*

*ta L.*

*n, dry upland woods, clay or sand.*

*ta bicolor Pursh.*

*nal, with the last.*

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‡*Viola primulaefolia australis* Pollard.

Locally common, open marshy places, Lee county, Tallapoosa county.

*Viola Rafinesquii* Greene.

Very common, fields and waste places.

*Viola striata* Ait.

Clay county (Mohr's Plant Life).

‡*Viola vicinalis* Greene.

Frequent, open sandy woods, not found on clay.

*Viola villosa* Walt.

Rare, dry pine woods, Auburn.

PASSIFLORACEAE.

*Passiflora incarnata* L.

Common, a troublesome weed in fields, especially clay. white flowered form is occasionally seen.

*Passiflora lutea* L.

Occasional, dry thickets.

CACTACEAE.

*Opuntia humifusa* Raf.

Frequent, roadsides and sandy land.

LYTHRACEAE.

‡*Lagerstroemia Indica* L.

Frequent, roadsides escaped, (Crape myrtle.)

*Rotala ramosior* (L.) Koehne.

A single collection, Clay county.

MELASTOMACEAE.

‡*Rhexia ciliosa* Michx.

A single collection, south of Auburn.

*Rhexia lanceolata* Walt.

Occasional, wet sandy places.

*Rhexia Mariana* L.

Frequent, wet sandy places.

‡*Rhexia stricta* Pursh.

A single collection, Auburn. (P. H. Mell.)

*ginica* L.

t, wet sandy places, also on clay

# ONAGRACEAE.

*coloratum* Muhl.

e county (Mohr's Plant Life).

*auxii* Spach.

t, dry woods and roadsides.

*ia speciosa* (Nutt.) Small.

, roadsides escaped.

*lustris* L.

al, ditches and running streams.

*currens* (Walt.) D. C.

t, ditches and wet open places.

*otocarpa* Nutt.

t, ditches and wet open places.

*nearis* (Michx.) Spach.

e collection, Chilton county.

*nifolia* (Nutt.) Spach.

s collection, Lee county.

*ngipedicellata* Small.

, dry open mixed woods, also in second growth woods,

r sand.

*ubglobosa* Small.

t, moist open sandy places.

*lternifolia* L.

, wet places, clay or sand.

*hirtella* Raf.

margins of ponds, sandy land.

*inearis* Walt.

t, wet places, sandy land.

*laciniata* Hill.

, fields and roadsides, a winter weed.

*laciniata grandis* Britt.

collection, fields near Auburn.

*nnis* (L.) Scop.

, fields and roadsides.

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## HALORAGIDACEAE.

*Myriophyllum* sp.

Immature plants from a stream south of Auburn.

*Proserpinaca pectinata* Lam.

A single collection, roadside ditches, sandy land.

## ARALIACEAE.

*Aralia spinosa* L.

Frequent, rich woods and thickets.

## UMBELLIFERAE.

*Angelica villosa* (Walt.) B. S. P.

Frequent, dry pine and mixed woods, clay or sand.

*Chaerophyllum Tainturieri* Hook.

Common, a street and roadside weed, also in sandy swamps.

*Centella Asiatica* (L.) Urban.

Lee county (S. M. Tracy.) Specimen in herb. New York Bot. Garden.

\**Cicuta maculata* L.

Common, swamps, etc.

‡*Daucus pusillus* Michx.

Frequent, fields, roadsides and waste places

*Deringa Canadensis* (L.) O. Kuntze.

Rich woods, Clay county, Coosa county.

‡*Hydrocotyle verticellata* Thurnb.

Frequent, shaded thickets, clay or land.

*Eryngium yuccaefolium* Michx.

Common, dry woods and fields.

*Oxypolis rigidus* (L.) Raf.

Frequent, sandy swamps.

†*Ligusticum Canadense* (L.) Britt.

Frequent, open marshy places.

1. This is included under *E. integrifolium* Walt. in Mohr's Plant Life, 644, but it seems to differ from the pine-barren plant in more diffuse habit and broader leaves.

- rigidus (L.) Britt.  
 at, open marshy places.  
 Nuttallii D. C.  
 nty. Baker & Earle) (Mohr's Plant Life).  
 n capillaceum (Michx.) Hollick.  
 n, sandy swamps.  
 canadensis L.  
 n, moist to rather dry woods.  
 Floridana Bicknell. 1.  
 at, dry upland woods.  
 Marylandica L.  
 nal, moist woods.  
 mallii Bicknell.  
 at, creek bottom woods.  
 parbinode (Michx.) Nutt.  
 nal, moist thickets, etc  
 trifoliatum aureum (Nutt.) Britt.  
 nal, creek bottom woods.  
 a (L.) Koch.  
 e collection, Clay county.  
 ta (Walt.) D C.  
 at, upland woods, sand or clay.

#### CORNACEAE.

- omum Mill.  
 a, along streams.  
 icta Lam.  
 nty Earle & Baker (Mohr's Plant Life).  
 ida L.  
 a, upland woods, clay or sand.  
 ora Walt.  
 a, swamps.  
 r's Plant Life, 645, includes this *with S. Canadensis*.  
 wo seem sufficiently distinct. The shape of the leaves  
 he general aspect are so different that they can be dis-  
 shed at a glance.

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*Nyssa sylvatica* Marsh.

Common, upland woods, usually clay.

## PYROLACEAE.

†*Chimaphila maculata* (L.) Pursh.

Occasional, dry pine woods.

## MONOTROPACEAE.

*Monotropa uniflora* L.

Occasional, rich woods.

## ERICACEAE

*Azalea arborescens* Pursh.

Rare, along streams, clay land

*Azalea nudiflora* L.

Common, rich woods.

*Azalea viscosa* L.

Common, swamps, variable.

*Azalea viscosa glauca* (L.) Michx.

Lee county, Earle &amp; Underwood (Mohr's Plant Life).

*Bathodendron arboreum* (Marsh.) Nutt.Common, dry woods (*Vaccinium Arboreum* Marsh.)*Epigaea repens* L.

Rare, dry hillsides, Lee county, Tallapoosa county.

*Gaylussacia dumosa* (Andr.) T. & G.

Common, dry hillsides.

*Gaylussacia frondosa* (L.) T. & G.

Frequent, dry rocky hillsides.

\**Gaylussacia nana* (A. Gray) Small.

Frequent, dry rocky hills.

*Kalmia latifolia* L.

Common, along streams.

†*Leucothoe racemosa* (L.) A. Gray.

Border of ponds, sandy land.

*Oxydendron arboreum* (L.) D C.

Frequent, dry or moist woods.

‡*Pieris nitida* (Bartr.) B. & H.

Frequent, sandy swamps.

- melanocarpum* (Mohr) Greene.  
 dry upland woods.
- melanocarpum candicans* (Mohr).  
 dry upland woods.
- amineum* (L.) Greene.  
 dry woods.
- on punctatum*, Andr.  
 collection, river hills, Tallapoosa county.
- moenum* Ait.  
 dry hillsides.
- rymbosum* L.  
 open woods.
- tiottii* Chapm.  
 banks of streams.
- uscatum* Ait.  
 sphagnum bogs.
- ysinites* Lam.  
 dry rocky hills.
- ysinites glaucum* A. Gray.  
 with the type.
- hellum* Ait.  
 moist hillsides.
- cellans* Kalm.  
 dry rocky hills.
- irgatum* Ait.  
 banks of streams.
- strina* (L.) Britt.  
 moist woods, banks of streams.

# PRIMULACEAE.

- quadrifolia* L.  
 collection, Talladega county.
- bundus* H. B. K.  
 swamps.
- liatum* (L.) Raf.  
 moist woods.
- anceolatum* (Walt.) A. Gray.  
 moist woods.

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*Steironema lanceolatum angustifolium* A. Gray.

Lee county. (Earle & Baker) (Mohr's Plant Life).

\**Steironema quadriflorum* (Sims) A. S. Hitchcock.

A single collection, moist woods, Auburn, clay land.

*Steironema tonsum* (Wood) Bicknell.

A single collection, Clay county.

#### EBENACEAE.

*Diospyros Virginiana* L.

Common, dry woods (=Vaccinum Arboreum Marsh.)

#### SIMPLOCACEAE.

*Symplocos tinctoria* (L.) L'Her.

Frequent, moist hillsides and along streams.

#### STYRACEAE.

*Mohrodendron Carolinum* (L.) Britt.

Common, along streams.

†*Mohrodendron dipterum* (Ell.) Britt.

Banks of Tallapoosa river, Elmore county, Tallapoosa county.

*Styrax Americana* Lam.

Common, along streams.

*Styrax grandiflora* Ait.

Rare, upland woods, clay land.

#### OLEACEAE.

*Chionanthus Virginica* L.

Occasional, moist woods and along streams.

*Fraxinus lanceolata* Bork.

Occasional, creek and river bottoms.

†*Osmanthus Americanus* (L.) B. & H.

Frequent, along streams and moist hillsides.

#### LOGANIACEAE.

\**Buddleia Japonica* Hemsl.

Sparingly escaped, roadsides.

*Gelsemium sempervirens* (L.) Ait.

Frequent, climbing over trees in moist or dry thickets, sand or clay (Yellow jasmine.)

*procumbens* L.  
dry field and waste places.

*landica* L.  
rich, shady woods.

#### GENTIANACEAE.

*tinica* (L.) B. S. P.  
swampy swamps.

*ponaria* L.  
along creek banks.

*osa* L.  
dry woods, usually clay.

*ularis* (L.) Pursh.  
dry rich woods, usually clay.

*kinii* A. Gray.  
woods, Clay county, Coosa county.

#### MENYANTHACEAE.

*um lacunosum* (Vent.) Griseb.  
h of Auburn.

#### APOCYNACEAE.

*onia* (L.) Britt.  
creek bottom woods.

*nnabinum* L.  
y fields, south of Auburn.

#### ASCEPIADACEAE.

*plexicaulis* Michx.  
dry sand hills south of Auburn, never in clay.

*isifolia* Michx.  
thin upland woods, clay or sand.

*rosa* L.  
ry woods and roadsides.

*egata* L.  
ry woods and roadsides, sand or clay.

*cillata* L.  
ry woods and roadsides, sand or clay.

*Vincetoxicum hirsutum* (Michx.) Britt.  
Occasional, rich woods, usually clay.

#### CONVOLVULACEAE.

‡*Breweria humistrata* (Walt.) A Gray.  
Frequent, dry sandy pine woods.

‡*Convolvulus repens* L.  
Frequent, dry woods, sand or clay.

*Ipomoea barbiger*a (Don.) Sweet.  
Common, upland fields.

*Ipomoea hederacea* Jacq.  
Lee county, Earle (Mohr's Plant Life).

*Ipomoea lacunosa* L.  
Occasional, creek bottom fields.

*Ipomoea pandurata* (L.) Meyer.  
Frequent, dry woods and roadsides.

*Ipomoea purpurea* (L.) Roth.  
Lee county, Earle (Mohr's Plant Life).

‡*Jacquemontia tamnifolia* (L.) Griseb.  
Common, a weed in fields.

‡*Quamoclit coccinea* (L.) Moench.  
Occasional, cultivated fields.

#### CUSCUTACEAE.

*Cuscuta arvensis* Beryrich.  
Lee county, Earle (Mohr's Plant Life).

*Cuscuta* sp.  
Other species occur, but the specimens have not been determined.

#### POLEMONIACEAE.

*Phlox amoena* Sims.  
Frequent, dry pine and mixed woods.

*Phlox glaberrima* L.  
Frequent, dry mixed woods.

*Phlox maculata* L.  
Occasional, upland woods.

ulata L.  
 collection, Coosa county.  
 ulata acuminata (Pursh) Chapm.  
 y, Baker & Earle (Mohr's Plant Life).  
 L.  
 moist mixed woods.

## HYDROPHYLLACEAE.

rivalvis (Walt.) O. Kuntze.  
 of pond south of Auburn.  
 bia (L.) Small.  
 abundant, dry granite outcrops.

## BORAGINACEAE.

a Indicum L.  
 l, roadsides and waste places.  
 ginica (L.) Greene.  
 l, moist woods, clay land.  
 cabriuscula Ait.  
 l, open grassy places.  
 Carolinianum (Lam.) A. D. C.  
 l, dry sandy fields and open woods.

## VERBENACEAE.

americana L.  
 dry woods, sand or clay. A form with white fruit  
 teosa Michx.  
 l, roadsides and waste places.  
 roliniana Michx.  
 dry sandy woods.  
 s-castus L.  
 escaped, roadsides, etc.

ture specimens of this plant were determined as  
 is Virginica and were so reported in Mohr's Plant  
 01. The true M. Virginica has not so far been found.

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## LABIATAE.

†*Blephila ciliata* (L.) Raf.

Frequent, dry hillsides, clay land.

†*Clinopodium Nepeta* (L.) O. Kuntze.

A single collection, Clay county.

*Clinopodium Carolinianum* (Michx.) Heller.

Locally common, dry sandy flats, banks of Tallapoosa  
Tallapoosa county.

*Collinsonia anisata* Pursh.

Common, dry pine and mixed woods.

\**Collinsonia Canadensis punctata* A Gray.

A single collection, swamp south of Auburn.

*Collinsonia scabriuscula* Ait.

Opelika, Lee county (Mohr's Plant Life).

*Hedeoma pulegioides* (L.) Pers.

Tallapoosa county, Clay county, not found at Auburn.

‡*Koellia albescens* (T. & G.) O. Kuntze.

A single collection, Clay county.

*Koellia flexuosa* (Walt.) Mac M.

Occasional, moist open places.

\**Koellia incana* (L.) O. Kuntze.

Common, dry open woods.

*Koellia pycnanthemoides* (Leavenw.) O. Kuntze.

Common, dry open woods.

*Lamium amplexicaule* L.

Common, fields and gardens, a Winter weed.

*Lycopus Virginicus* L.

Common, wet swampy thickets.

*Mentha piperata* L.

Spring branches, Tallapoosa county.

‡*Mesosphaerum rugosum* (L.) Pollard.

Frequent, sandy swamps.

\**Monarda mollis* L.

Frequent, Clay county, not seen at Auburn.

*Monarda punctata* L.

Frequent, dry thickets.

*Nepeta cataria* L.

Clay county (Mohr's Plant Life).

- garis L.  
moist places.
- a Lam.  
open sandy places, roadsides, etc.
- t L.  
dry or moist woods.
- folia L.  
dry open woods.
- ordifolia Muhl.  
l, mixed woods, clay land.
- ntegrifolia major Chapm.  
moist creek bottoms, usually sandy land.
- hyssopifolia L.  
collection, Auburn.
- aterifolia L.  
collection, Auburn.
- ilosa Michx.  
dry mixed woods.
- venosa Kearney.  
once, Tallapoosa county.
- dichotomum L.  
Clay county, not seen at Auburn.
- a lineare Nutt.  
open sandy woods.

## SOLANACEAE.

- ila L.  
barnyards and rich gardens.
- ulata L.  
l, gardens and fields.
- 
- l. This is a striking species, the plant covered with  
hittish hairs. Dr. Rydberg considers it new and will  
ublish a description. An unnamed fragment of the  
thing collected by Dr. Chapman is in the Columbia  
sity herbarium.
- eginiana Mill.  
dry open woods, clay or sand.

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**Physalodes Physalodes (L.) Britt.**

Occasional, gardens and rich fields.

**Solanum Carolinense L.**

Common, fields and gardens.

**Solanum nigrum L.**

Common, rich fields and gardens.

**Solanum pseudocapsicum L.**

Occasional, roadsides.

**SCROPHULARIACEAE.****†Afzelia cassinoides (Walt.) Gmel.**

A single collection Clay county.

**Afzelia pectinata (Pursh) O. Kuntze.**

Frequent, dry pine or mixed woods.

**Buchnera Americana L.**

Rare, moist open places.

**Chelone glabra L.**

Rare, moist thickets.

**\*Dasystoma bignoniflora Small.**

A single collection, Clay county.

**Dasystoma flava (L.) Wood.**

Frequent, dry woods.

**Dasystoma pectinata (Nutt.) Benth.**

Lee county, Baker &amp; Earle (Mohr's Plant Life).

**Dasystoma laevigata (Raf.) Chapm.**

Frequent, dry woods.

**†Dasystoma Virginica (L.) Britt.**

Frequent, rich woods.

**\*Gerardia microphylla (A. Gray) Small.**

Occasional, sandy pine woods.

**Gerardia Plukenetii Ell.**

Frequent, dry upland woods, clay or sand.

**Gerardia purpurea L.**

Occasional, wet swampy places.

Frequent, dry woods.

**Gratiola Floridana Nutt.**

Locally abundant, swamps. Lee county, Tallapoosa cou

*Cratiola pilosa* Michx.

Frequent, moist open places.

*Cratiola sphaerocarpa* Ell.

Frequent, boggy places.

*Cyananthes attenuata* (Muhl.) Small.

A single collection, bank of pond south of Auburn.

*Cyananthes refracta* (Ell.) Benth.

Occasional, moist granite outcrops.

*Gerardia Canadensis* (L.) Dumort.

Common, fields and gardens.

*Geranthemum emarginatum* Ell.

A single collection, border of pond south of Auburn.

*Impatiens ringens* L.

Frequent, wet ditch banks, etc., clay land.

*Impatiens acuminata* (Walt.) O. Kuntze.

Frequent, wet, swampy woods.

*Impatiens Canadensis* L.

Occasional, moist pine or mixed woods.

*Impatiens hirsutus* (L.) Willd.

Common, dry woods.

*Impatiens Marylandica* L.

Infrequent, the only collection from Coosa county.

*Impatiens Blattaria* L.

Rare about Auburn, becoming common farther north.

*Impatiens Thapsus* L.

Occasional, roadsides and waste places.

*Impatiens arvensis* L.

Occasional, fields and waste places.

*Impatiens peregrina* L.

Frequent, fields and waste places.

#### LENTIBULARIACEAE.

*Lentibularia fibrosa* Walt.

In mud border of pond south of Auburn ,

*Lentibularia subulata* L.

Frequent, sandy swamps.

## OROBANCHACEAE.

†*Conopholis Americana* (L.) Walt.

Frequent, moist woods, growing on oak, beech and sweet gum roots.

†*Lepplamnium Virginianum* (L.) Raf.

Frequent, moist woods.

†*Thalesia uniflora* (L.) Britt.

Rare, mixed woods.

## BIGNONIACEAE.

*Bignonia crucigera* L.

Frequent, along streams.

*Campsis radicans* (L.) Seem.

(=*Tecoma radicans* D C.)

Common, thickets, roadsides and fields.

*Catalpa Catalpa* (L.) Karst.

Occasional, along streams.

## ACANTHACEAE.

*Dianthera Americana* L.

Frequent, in running streams.

*Ruellia ciliosa hybrida* (Pursh) A. Gray.

Lee county, Baker & Earle (Mohr's Plant Life).

*Ruellia ciliosa parviflora* (Nees) Britt.

Occasional, roadsides and mixed woods, clay land, also on granite outcrops.

*Ruellia strepens* L.

Clay county (Mohr's Plant Life).

## PLANTAGINACEAE.

*Plantago aristata* Michx.

Common, roadsides and waste places.

\**Plantago elongata* Pursh.

Collected once, creek bottom pasture, Auburn.

*Plantago heterophylla* Nutt.

Common, fields and waste places.

*Antago lanceolata* L.

Occasional, roadsides and grassy places.

*Antago Rugelii* Dee.

Occasional, moist pastures and roadsides.

*Antago Virginica* L.

Common, fields, pastures and waste places.

## RUBIACEAE.

*Phalanthus occidentalis* L.

Common, swamps and moist thickets.

*Rodia teres* Walt.

Very common, old fields, roadsides, etc.

*Rodia Virginiana* L.

Common, ditch banks and wet fields.

*Rhium aparine* L.

Occasional, gardens and moist places.

*Rhium circaezans* Michx.

Collected once, Auburn, not typical.

*Rhium Clayteni* Michx.

Collected once, shaded spring bog, Auburn.

*Rhium pilosum* Ait.

Frequent, pine and mixed woods.

*Rhium pilosum punctulosum* (Michx.) T. & G.

Frequent, dry pine woods.

*Rhium uniflorum* Michx.

Collected once, moist, rich woods, Auburn.

*Rhium tinctorium* L.

Occasional, moist woods.

*Rhium triflorum* Michx.

Occasional, rich woods, Lee county, Clay county.

*Roustonia calycosa* (Shuttly.) Mohr.

Tallapoosa county (Mohr's Plant Life).

*Roustonia coerulea* L.

Common, open pine and mixed woods.

*Roustonia longifolia* Gaertn.

Occasional, moist, rocky banks.

*Roustonia minor* (Michx.) Britt.

Common, pastures and open places.

*Houstonia purpurea* L.

Common, rich woods, usually on clay.

*Houstonia tenuifolia* Nutt.

Frequent, dry open, deciduous woods clay land.

*Mitchella repens* L.

Common, moist creek banks and sandy swamps.

†*Oldenlandia uniflora* L.

Frequent, borders of sphagnum swamps.

†*Richardia scabra* L.

Common, sandy cultivated fields, Lee county, Elmore county.

## CAPRIFOLIACEAE.

*Lonicera flava* Sims.

Clay county (Mohr's Plant Life).

*Lonicera Japonica* Thunb.

Abundantly escaped roadsides, fields and thickets.

*Lonicera sempervirens* L.

Frequent, climbing in moist thickets.

*Sambucus Canadensis* L.

Common, thickets and roadsides.

†*Symphoricarpus* *Symphoricarpus* (L.) MacM.

Collected once, Clay county.

*Viburnum acerifolium* L.

Clay county (Mohr's Plant Life).

*Viburnum nudum* L.

Common, sandy swamps.

*Viburnum rufotomentosum* Small.

Occasional, moist or dry open woods.

## VALERIANACEAE.

*Valerianella radiata* (L.) Dufr.

Common, creek bottom fields.

## CAMPANULACEAE.

*Campanula Americana* L.

Collected once, Coosa county.

*Campanula divaricata* Michx.

Frequent, granite ledges Lee county, Tallapoosa county.

*ia biflora* (R. & P.) A. Gray.  
on sandy pastures and roadsides.

*a perfoliata* (L.) A. DC.  
on, fields and roadsides.

# LOBELIACEAE.

*moena* Michx.  
ent, sandy swamps.

*ardinalis* L.  
ent, swampy creek bottoms, often on clay.

*inflata* L.  
bottoms, Clay county, rare at Auburn.

*ptostachys* A. D C.  
county (Mohr's Plant Life).

*tuttallii* Roem. & Schult.  
county (Mohr's Plant Life).

*uberula* Michx.  
on, open woods, often near streams.

*picata* Lam.  
woods, Elmore county Coosa county Clay, county not  
at Auburn.

*pyphilitica* L.  
county (Mohr's Plant Life).

# CHICORIACEAE.

*Carolinianum* (Walt.) Britt.  
on, fields, roadsides and waste places.

*Greenii* Porter & Britt.  
ounty. (Baker & Earle.) Mohr's Plant Life.)

*Gronovii* L.  
ent, dry pine and mixed woods.

*Marianum* Willd.  
ional, dry hillsides.

*Scribneri* Small.  
Coosa county (Mohr's Plant Life).

*venosum* L.  
on, dry rocky wooded hillsides.

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**Lactuca Canadensis L.**

Common, pine woods and open places.

**Lactuca Floridana (L.) Gaertn.**

Collected once, Auburn.

**Lactuca graminifolia Michx.**

Occasional, sandy pine woods.

**†Lactuca hirsuta Muhl.**

Occasional, pine woods.

**Lactuca sagittifolia Ell.**

Clay county (Mohr's Plant Life).

**‡Lactuca villosa Jueq.**

Occasional, roadsides.

**†Nabalus altissimus (L.) Hook.**

Occasional, moist, rich woods, usually creek bottoms.

**Nabalus Serpentaria (Pursh) Hook.**

Frequent, moist, dry woods, often uplands.

**\*Nabalus trifolatus Cass.**

Collected once, Auburn, in a garden.

**Serinea oppositifolia (Raf.) O. Kuntze.**

Occasional, creek bottom fields.

**Sitilias Caroliniana (Walt.) Raf.**

Common, fields, roadsides and open places. A white flowered form occurs.

**Sonchus asper (L.) All.**

Frequent, fields and waste places.

**CARDUACEAE.****‡Acanthospermum australe (L.) O. Kuntze.**

Frequent, along railroad embankments.

**Ambrosia artemisiaefolia L.**

Common, fields, etc. (dog weed).

**\*Antennaria nemoralis Greene.**

Frequent, dry rocky hillsides and granite outcrops.

**Antennaria plantaginifolia (L.) Richards.**

Lee county (Mohr's Plant Life).

**Anthemis Cotula L.**

Occasional, roadsides and waste places, usually not abundant.

- Leptosorus* Small.  
 on, shaded, rocky hillsides.
- color* L.  
 on, dry sandy roadsides and open woods.
- aricatus* L.  
 ed once, Clay county.
- osus* L.  
 onal, borders of fields and thickets. ,
- oides* L.  
 on, swamps and waste places.
- oides platyphyllus* T. & G.  
 unty. (Baker & Earle.) (Mohr's Plant Life.)
- oides pilosus* (Willd.) Porter.  
 on, fields, roadsides and waste places.
- suticaulis* Lindl.  
 ed once, Auburn.
- thinus* Burgess.  
 ed once, Auburn.
- s* L.  
 unty (Mohr's Plant Life).
- riflorus* (L.) Britt.  
 on, alder swamps, wet thickets and borders of fields.
- ngiolius* Nutt.  
 unty (Mohr's Plant Life).
- ns* Ait.  
 on, roadsides and dry woods, clay land.
- ceus* L.  
 on, alder swamps and moist thickets.
- rpuratus* Nees.  
 nt, clay roadsides.
- ttifolius* Willd.  
 ed once, Auburn.
- rtii* Hook.  
 banks, Tallapoosa river, Elmore county.,
- descanti* L.  
 nt, moist, shady woods.

‡*Aster dumosus cordifolius* (Michx.) T. & G.

Very common, dry rocky hillsides. Exceedingly variable.  
collections probably include several of the named varieties.

*Aster vimineus foliosus* (Ait.) A. Gray.

Lee county (Mohr's Plant Life).

*Aster undulatus* L.

Common, cultivated fields and waste places.

*Bidens frondosa* L.

Common, fields and swampy places.

‡*Brauneria purpurea* (L.) Britt.

Collected once, clay roadsides, Chambers county.

*Carduus altissimus* L.

Common, moist thickets, etc.

\**Carduus discolor* (Muhl.) Nutt.

Occasional, moist thickets and open woods.

*Carduus lanceolatus* L.

Clay county (Mohr's Plant Life.)

‡*Carduus spinosissimus* Walt.

Rare, open sandy land.

*Carduus spinosissimus Elliotti* (T. & G.) Porter.

Common, old fields, roadsides and open woods, mostly on clay.  
Worthy of specific rank, often reaches more than three feet  
in height.

*Carduus Virginianus* L.

Occasional, sandy roadsides.

‡*Chrysogonum Virginicum* L.

Occasional, deciduous woods, clay land.

*Chrysopsis graminifolia* (Michx.) Nutt.

Very common, pine and mixed woods, especially on sand.

*Chrysopsis Mariana* (L.) Nutt.

Common, pine and mixed woods.

*Cnicus benedictus* L.

Collected once, railroad tracks, Auburn.

‡*Coleosanthus cordifolius* (Ell.) O. Kuntze.

Occasional, sandy woods and roadsides.

*Coreopsis auriculata* L.

Common, moist pine and mixed woods, clay or sand.

\**Coreopsis bicolor*.

Collected once, fields south of Auburn, escaped.

*opsis delphinifolia* Lam.

Collected once, fields, Chambers County.

*opsis grandiflora* Hogg.

Locally abundant, moist granite outcrops.

*opsis lanceolata* L.

Frequent, open pine woods, usually sand.

*opsis major* Walt.

Common, dry pine and mixed woods.

*opsis Oemleri* Ell.

Frequent, dry pine and mixed woods. It intergrades freely with the last species and can hardly be considered distinct.

*opsis pubescens* Ell.

Collected once, Tallapoosa County.

*opsis tripteris* L.

Occasional, ditch banks and margins of creek bottom fields, clay land.

*opsis verticillata* L.

Lee county, (Mohr's Plant Life).

*ellingeria humilis* (Willd.) Britt.

Occasional, creek bottom woods.

*ellingeria infirma* (Michx.) Greene.

Collected once, Lee County; once, Clay County.

*hantopus Carolinianus* Willd.

Frequent, creek bottom woods and thickets, clay or sand.

*phantopus elatus* Bertol.

Collected once, Auburn; once Macon County.

*hantopus nudatus* A. Gray.

Common, shaded creek bottoms, sandy land.

*hantopus tomentosus* L.

Common, creek bottoms and dryer locations, in shade or exposed, clay or sand.

*htites hieracifolia* (L.) Raf.

Frequent, rich newly-cleared fields and waste places.

*eron annuus* (L.) Pers.

Occasional, moist creek bottom fields and waste places.

*eron Philadelphicus* L.

Collected once, Auburn; moist woods, clay.

*geron pulchellus* Michx.

Frequent, rich woods.

†*Erigeron ramosus* (Walt.) B. S. P.

Common, fields roadsides and waste places.

*Erigeron ramosus* Beyrichii (F. & M.) Smith & Poir.

Lee county. (Baker & Earle.) (Mohr's Plant Life.)

*Eupatorium ageratoides* L.

Occasional, creek bottom swamps.

*Eupatorium album* L.

Common, dry woods, clay or sand.

*Eupatorium amoenum* Pursh.

Clay county, (Mohr's Plant Life.)

*Eupatorium aromaticum* L.

Common, dry pine and mixed woods.

*Eupatorium capillifolium* (Lam.) Small.

Very common, pastures, old fields, roadsides and waste places usually in moist land.

‡*Eupatorium coelestinum* L.

Occasional, swamps.

*Eupatorium compositifolium* Walt.

Frequent, dry old fields and open woods.

*Eupatorium cuneifolium* Willd.

Frequent, dry sandy pine woods.

*Eupatorium hyssopifolium* L.

Occasional, dry sandy woods.

*Eupatorium linearifolium* Walt.

Lee county. (Baker & Earle.) (Mohr's Plant Life.)

*Eupatorium perfoliatum* L.

Common, swampy places, clay or sand.

\**Eupatorium petaloideum* Britt.

Collected once, Auburn.

*Eupatorium pinnatifidum* Ell.

Rare, dry open woods.

*Eupatorium pubescens* Muhl.

Lee count. (Baker & Earle.) (Mohr's Plant Life.)

*Eupatorium purpureum* L.

Common, creek bottoms and swamps, especially clay land

*Eupatorium rotundifolium* L.

Common, creek bottoms, usually sandy land.

*atorium semiserratum* D C.

Frequent, sandy pine woods.

*atorium serotinum* Michx.

Occasional, moist roadsides and waste places.

*atorium Smithii* Greene & Mohr.

Chambers County. (Mohr, Plant Life.)

*atorium Torreyanum* Short.

Clay roadsides, Chambers county.

*atorium tortifolium* Chapm.

Frequent, dry sandy pine woods.

*atorium verbenaeifolium* Michx.

Common, swampy woods, sandy land.

*lardia lanceolata* Michx.

Common, open sandy pine woods, etc.

*aphalium Helli* Britt.

Common, open pine and mixed woods.

*halium purpureum* L.

Common, a winter weed in fields and waste places.

*halium obtusifolium* L.

Lee county. (Baker & Earle.) (Mohr's Plant Life.)

*aphalium Helli* Britt.

Collected once, banks of Tallapoosa river.

*ium autumnale* L.

Common, with the last.

*enium Nuttallii* A. Gray.

Frequent, alder swamps and creek bottoms.

*enium tenuifolium* Nutt.

Very common, fields, pastures and roadsides; (bitter weed.)

*nthus angustifolius* L.

Common, open swampy places.

*nthus atrorubens* L.

Occasional, roadsides and woods, clay land.

*nthus divaricatus* L.

Frequent, dry woods and roadsides.

*nthus hirsutus* Raf.

Frequent, dry woods and roadsides.

*nthus hirsutus trachyphyllus* T. & G.

Clay county. (Mohr's Plant Life.)

*Helianthus microcephalus* T. & G.

Common, dry woods and roadsides.

*Helianthus Sweinitzii* T. & G.

Lee County, (Mohr, Plant Life.)

*Helianthus tomentosus* Michx.

Frequent, rich mixed woods.

*Heliopsis gracilis* Nutt.

Occasional, moist upland woods.

*Heliopsis helianthoides* (L.) B. S. P.

Collected once, Tallapoosa County.

*Ionactis linariifolia* (L.) Greene.

Common, roadsides and open pine woods, sandy land.

*Isopappus divaricatus* (Nutt.) T. & G.

Very common, old fields, pastures and roadsides.

*Kuhnia eupatorioides* L.

Common, dry open woods, usually on sandy land.

\**Lacinaria Earlei* Greene.

Auburn. (F. S. Earle, 1896.)

‡*Lacinaria elegans* (Walt.) O. Kuntze.

Locally abundant, sandy pine woods, south of Auburn.

\**Lacinaria elegantula* Greene.

Auburn. (F. S. Earle, 1896.)

‡*Lacinaria graminifolia* (Walt.) O. Kuntze.

Common, dry pine and mixed woods. A form with flowers occurs.

‡*Lacinaria scariosa squarrulosa* (Michx.) Small.

Collected once, Auburn.

‡*Lacinaria spicata* (L.) O. Kuntze.

Occasional, pine woods.

*Lacinaria squarrosa* (L.) Hill.

Occasional, dry woods.

*Leptilon Canadense* (L.) Britt.

Common, cultivated fields.

‡*Mariana Mariana* (L.) Hill.

Collected once, streets of Auburn.

*Marshallia lanceolata* Pursh.

Frequent, open pine and mixed woods.

*Marshallia trinerva* (Walt.) Porter.

Occasional, thickets along small streams.

- triplicifolia* (L.) Raf.  
 Tallapoosa river, Tallapoosa county.  
*vata* (Walt.)  
 moist mixed woods.  
*eniformis* (Muhl.) Raf.  
 once, Clay county.  
*integrifolium* L.  
 ty, Tallapoosa county, Lee county, (Mohr, Plant  
*cida* (L.) B. S. P.  
 , swamps and creek bottoms.  
*olata* Cass.  
 creek bottoms and swamps.  
*nadensis* L.  
 ty (Mohr's Plant Life.)  
*nadensis radiata* A. Gray.  
 lladega mountains, Clay county.  
*edalia* L.  
 , roadsides and moist open woods.  
*lgida* Ait.  
 moist upland woods.  
*rta* L.  
 dry open woods.  
*ciniata* L.  
 creek bottoms and swamps.  
*athulata* Michx.  
 ty, Talladega county, Lee county, (Mohr's Plant  
*iloba* L.  
 once, northern Lee county.  
*uncata* Small.  
 once, Auburn.  
*ei* Small.  
 mon, dry open woods and waste places.  
*us* Pers.  
 on, creek bottoms.  
*mingeri* Britt.  
 y. (Underwood & Earle.) (Mohr's Plant Life.)



**Senecio obovatus** Muhl.

Lee county. (Baker &amp; Earle.) (Mohr's Plant Life.)

**Senecio Smallii** Britt.

Clay county, Tallapoosa county, Lee county, (Mohr's P

**Sericocarpus asteroides** (L.) B. S. P.

Common, dry pine and mixed woods.

**Sericocarpus bifolius** (Walt.) Porter.

Occasional, dry sandy pine woods.

**Sericocarpus linifolius** (L.) B. S. P.

Common, dry pine or mixed woods.

**Silphium asperum** Hook.

Clay county. (Mohr's Plant Life.)

**Silphium asteriscus** L.

Common, upland woods, clay or sand.

**Silphium compositum** Michx.

Common, upland woods, clay or sand.

**Silphium dentatum** Ell.

Lee county. (Baker &amp; Earle.) (Mohr's Plant Life.)

**Silphium laevigatum** Pursh.

Lee county. (Baker &amp; Earle.) (Mohr's Plant Life.)

**Silphium trifoliatum** L.

Clay county (Mohr's Plant Life.)

†**Solidago amplexicaulis** T. & G.

Frequent, rocky hillsides, mixed woods.

**Solidago arguta** Ait.

Clay County. (Mohr, Plant Life.)

**Solidago Bootii** Hook.

Common, creek bottom woods.

**Solidago brachyphylla** Chap.

Lee county. (Earle.) (Mohrs' Plant Life.)

†**Solidago caesia** L.

Common, moist rich woods.

**Solidago Canadensis** L.

Very common, fields and waste places.

†**Solidago erecta** Pursh.

Frequent, dry sandy creek bottoms.

†**Solidago fistulosa** Mill.

Collected once, Clay county.

- go neglecta* T. & G.  
e county. (Baker & Earle.) (Mohr's Plant Life.)
- go nemoralis* Ait.  
ry common, dry roadsides, old fields and dry open second-  
growth woods.
- go odora* Ait.  
ry common, dry pine and mixed woods.
- go pallescens* Mohr.  
mmon, dry rocky hillsides, mixed woods.
- go patula strictula* T. & G.  
equent, moist woods, creek bottoms, etc.
- go petiolaris* Ait.  
mmon, sandy pine woods.
- go rugosa* Mill.  
mmon, creek bottoms, alder swamps.
- go salicina* Ell.  
e county (Mohr's Plant Life.)
- go serotina* Ait.  
mmon, creek bottom fields and moist places.
- go ulmifolia* Muhl.  
mmon, creek bottom woods.
- go Vaseyi* Heller.  
ay county (Mohr's Plant Life.)
- gonotheca helianthoides* L.  
mmon, dry open woods and roadsides, usually sandy land.
- ina alternifolia* (L.) Britt.  
ay county (Mohr's Plant Life.)
- ina aristata* (Ell.) Heller.  
mmon, dry pine and mixed woods.
- sina Virginica* L.  
equent, dry open creek bottom woods.
- ia angustifolia* Michx.  
mmon, sandy pine woods, occasional on clay.
- onia Baldwini* Torr.  
llected once, Auburn.

**\*Vernonia flaccidifolia Small. 1.**

Occasional, upland clay woods.

**\*Vernonia glauca (L.) Britt.**

Collected once, Auburn.

**†Vernonia maxima Small. 2.**

Frequent, alder swamps, etc., reaching 10 or 12 feet.

**\*Vernonia noveboracensis (L.) Willd.**

Occasional, fields, pastures and roadsides.

**\*Vernonia ovalifolia T. & G. 3.**

Common, dry sandy woods.

**Willoughbia scandens (L.) O. Kuntze.**

Common, climbing in swamps.

**Xanthium glabratum (D C.) Britt.**

(=X. strumosum.)

1.—Some of these specimens were at first determined as *Vernonia fascicularis* Michx. and are so reported by Mohr, *Plant Life*, 758.

2.—This is the *Vernonia gigantea* (Walt.) Britt, reported from Clay county, Mohr, *Plant Life*.

3.—Distributed as *Vernonia Drummondii*.

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APRIL, 1902

ALABAMA.

# **ultural Experiment Station**

OF THE

**icultural and Mechanical College,**

AUBURN.

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## **OW PEA AND THE VELVET BEAN AS FERTILIZERS.**

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By J. F. DUGGAR.

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## THE COWPEA AND THE VELVET BEAN AS FERTILIZERS.

BY J. F. DUGGAR.

### *Summary.*

This bulletin records the results of more than fifty experiments conducted at Auburn during the past five years, to ascertain the effects of cowpeas and velvet beans in the improvement of the soil. The amount of soil improvement has been determined by the increase in the yields of cotton, corn, oats, wheat and sorghum, grown as first, second, third or fourth crops after the stubble and roots of cowpeas or velvet beans or after vines, stubble and roots of these plants have been plowed under. The basis for determining this increase has been the yield of each crop on plots where no leguminous plant has recently grown.

The fertilizing value of different varieties of cowpeas was found to vary considerably, and is probably in proportion to the luxuriance of growth.

In two tests there was a slightly larger yield of corn from plowing in cowpea vines very late in the fall than from postponing the plowing until April; but it is regarded as generally best to plow in the vines not more than a few weeks before the next crop is planted.

The average for six varieties showed that when cowpeas were at a suitable stage for mowing 36.6 per cent. and in another case 39 per cent. of the dry weight of the plant was available for fertilizing uses in stubble, roots and fallen leaves. In the entire growth of cowpeas on one acre there was contained in one case 53.7 pounds of nitrogen, in another 69.8, and in another 77.2, an average of 70.2 pounds of nitrogen per acre,

which is equivalent to the nitrogen in 1,003 pounds of cotton seed meal.

In the roots, stubble and fallen leaves on an acre there were, respectively, 11.65, 16.2 and 31.4 pounds of nitrogen, an average of 19.75 pounds of nitrogen per acre, which is equivalent to that contained in 282 pounds of cotton seed meal.

The average of three tests shows that 28 per cent. of the total nitrogen was contained in the roots, stubble and fallen leaves after the removal of the hay.

The average increase in the yields of succeeding crops was practically identical whether the fertilizing material was supplied by cowpeas or by velvet beans. Equal areas of these two plants were of practically equal value for soil improvement.

The word vines is here used as synonymous with the entire plant of the velvet bean, and with the entire plant of the cowpea after the pods are picked.

The increase in the yield of seed cotton produced in the year immediately following the plowing in of the vines of cowpeas or velvet beans averaged in four tests 567 pounds per acre, worth (at 6½ cents per pound for lint and \$7.50 per ton for seed) \$14.17. The increase in the first cotton crop after the use as fertilizers of the vines of the summer legumes was never less than 32 per cent. and averaged 63 per cent.

In one test with corn the increase in the first crop where velvet bean vines had been plowed in was 8 per cent., of 12.3 bushels, worth at least \$6.15 per acre. With oats the average increase from the vines of the summer legumes in three tests averaged 17 bushels per acre, and with wheat the corresponding increase in two tests was 5.65 bushels per acre.

The increase in the yield of sorghum hay after cowpea and velvet bean vines averaged 87 per cent., or a

gain of 2.1 tons of hay per acre, worth, at \$6.67 \$14.02.

the vines of the cowpea or velvet bean were as hay and only the roots and stubble employed. The increase in the yield per acre of the crop following the stubble was as follows:

of seed cotton, or 18 per cent., worth \$5.20.

of corn, or 32 per cent.;

of oats, or 334 per cent.;

of wheat, or 215 per cent.;

of sorghum hay, or 57 per cent.

The greatest percentage increase from either the vines or the stubble of cowpeas or velvet beans was made by the fall sown oats, probably because these best stand the washing away or leaching out of the fertilizer material in the stubble or vines of the legumes. Especially on sandy soil those crops most completely utilize the fertilizing value of the legumes which leave the soil unoccupied for the shortest interval. It is therefore inadvisable for legumes to immediately succeed legumes in the rotation of crops, for non-leguminous crops like cotton, corn, the small grains, grasses, etc., make better use of the nitrogen of the fertilizing

value of the increased product resulting from the entire legume for fertilizer was greater with sorghum than with corn, oats or wheat.

These experiments emphasize the importance of such a rotation of crops as will require a large proportion of cultivated land of every farm to be devoted to leguminous plant.

Comparing the fertilizing effect of the vines with that of the stubble of the cowpea and the velvet bean, the results for the next crop in favor of the vines averaged

as follows:

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6.6 bushels of corn per acre, or.....49 per cent.  
 .5 ton of sorghum hay, or ..... 9 per cent.  
 452 pounds of seed cotton per acre, or....40 per cent.

With these three crops the average increase in value per acre was \$5.98 greater from vines than from stubble. With oats and wheat the vines of these summer legumes were not superior to the stubble when the small grains were sown immediately after the legumes matured.

The fertilizing effect of the *stubble* of cowpeas or velvet beans was very transitory on sandy land, the average increase in the second crop of corn after the stubble being only 1.34 bushels per acre, or 12 per cent., as compared with the yield of a plot that had not borne legumes.

The fertilizing effect of the *vines* of cowpeas and velvet beans was less transitory than that of the stubble, and the increase was 24 to 54 per cent. in the second crop, 14 per cent. in the third crop (oats), and the favorable effect was even perceptible in the fourth crop (sorghum) grown in the same year as the third. The total increase in value of the four crops occupying certain plots during the three years after the plowing under of the vines of cowpeas and velvet beans was \$42.97 per acre, an annual increase of \$14.32 per acre.

On the other hand, on very light soil the fertilizing effects of both stubble and vines had practically disappeared within twelve months after the plowing in of the legumes.

Corn as the second crop yielded 14 per cent., or 2.1 bushels more after legume vines than after legume stubble, this representing a value of \$1.05. The permanency of effect of legumes in soil improvement seems to be in proportion to the stiffness of the soil and to the mass of vegetable matter afforded by the legume, and the favorable influence of leguminous vines is apparently not less permanent than that of stable manure.

## INTRODUCTORY.

the improvement of the soil should be one of the aims of every farmer. Every increase in productiveness brings an even more marked increase in profits. Given rich soil, and almost any crop will pay if adapted to the local conditions and markets. Labor put in the cultivation of corn or cotton on extremely poor soil usually earns scant reward or none.

Fortunately much of the poorest worn land can be brought to a fair degree of productiveness. The means of soil improvement are various. Most thoroughly tested by long experience in Europe and America is the system of farming which depends for soil enrichment on the manure from a large number of livestock maintained on the farm, partly for immediate profit, and largely for use as manufacturers of fertilizers. This system should be much more generally followed in Alabama. However, its introduction will be gradual because of limited capital, inexperience, and the small number and poor quality of the native livestock that cannot serve as a foundation for stock raising.

Meantime the most immediately available method of increasing the fertility of the soils of the South consists in the free use of that class of leguminous plants, or legumes, which embraces cowpeas, velvet beans, soybeans, beggar weed, peanuts, hairy vetch, crimson clover, and numerous others.

When these plants are grown under suitable conditions specific enlargements occur on their roots and these are called root tubercles, or root nodules. The micro-organisms which live within these tubercles are able to assimilate the nitrogen of the air that circulates through the upper layers of the soil. This nitrogen which a part of the air was useless to plant life, but

within the tubercles it is changed into available fertilizer and is carried by the sap to every part of the leguminous plant. Hence we may speak of these tubercles as fertilizer factories where nitrogenous fertilizers are manufactured and whence they are sent to every part of the cowpea or velvet bean, or other leguminous plant. The plowing in of the legume gives this nitrogen to the soil for the use of other plants. Nitrogen when purchased in the form of cotton seed meal costs 15 cents per pound, but when it is furnished by legumes it is many times cheaper, the principal outlay being for seed and labor.

Great as is the need of the South for varied industrial development, the factories most urgently needed and paying largest dividends are those which every farmer can bring into being by the millions on the roots of such legumes as cowpeas, velvet beans, vetch, crimson clover, melilotus, bur clover, and alfalfa.

These crops afford nitrogen and vegetable matter, thus supplying the principal deficiencies of southern soils, and they may be either used directly and exclusively for this purpose, or with greater profit the tops may first be fed to livestock, thus affording a fold profit in animal products and fertilizer, while the stubble and roots are immediately available for soil improvement.

The stubble alone usually causes a sufficient increase in the yield of the following crop to more than pay the cost of seed, fertilizer, and cultivation of the legume, leaving the food value of the tops as a net gain.

The principal part of this bulletin is occupied with data obtained at Auburn during the past five years bearing on the extent and permanency of the fertilizing effect of cowpeas and velvet beans.

The following conditions prevailed in all of these tests unless otherwise specifically stated:

mes were grown in drills and cultivated and fertilized with acid phosphate or with phosphate and potash salt. The crops, corn, cotton, sorghum, and rye, used to measure the effects of the legumes, have received no applied nitrogen, but have been fertilized with phosphate.

In all tests is rather poor to extremely poor sandy upland, the white or gray being almost all and the reddish soil approaching a loam with a thin subsoil in the latter case.

After the stubble of the legumes have been plowed before the planting of the next crop.

The variety of cowpeas employed was the Wonderful.

During the crops the endeavor has been made to obtain comparative average prices, the error, if any, being bettering them too low rather than too high. Lint has been rated at  $6\frac{3}{4}$  cents per pound, cotton \$50 per ton, sorghum hay at \$6.67 per ton, corn 50 cents, oats 40 cents, and wheat 80 cents per bushel. No record is here made of the increase in the price of grain, straw or corn stover, assuming that this is about sufficient to cover the increased cost of planting and threshing.

#### TIME TO PLOW IN COWPEA VINES.

On the gray sandy upland soil the vines of drilled cowpeas were plowed under in the late fall of 1898 and on other plots plowing was deferred until the next planting time.

The yields of corn were as follows:

*Bushels of corn per acre following cowpea vines plowed under in late fall or early spring.*

	Bus. per acre.		
	1899	1901	Av.
Fall plowed .....	23.8	30.6	27.2
Spring plowed ..	20.8	29.7	25.2
Difference ....	3.0	0.9	1.9

The results are slightly in favor of plowing under cowpea vines in the latter part of the fall rather than in the spring. As the plots were not strictly uniform, further experiments are needed before definite conclusions can be drawn. It should be said that on July 5, 1899, the foliage of the corn plant was much greener where the cowpea vines had been turned under in the fall than on the other plots, though the ears were not discernably different.

It is usually regarded as best to avoid fall plowing on sandy land in the South unless a winter crop is to be grown. On heavy soils where fall plowing is otherwise desirable, the legumes should first be allowed to mature.

Unless otherwise stated the time of plowing under cowpea and velvet bean vines referred to in this bulletin is a few days or weeks before the planting of the crop that is to occupy the ground.

#### RELATIVE FERTILIZING VALUES OF DIFFERENT VARIETIES OF COWPEAS.

Corn was grown in 1898 and 1901 immediately following different varieties of drilled cowpeas which had been picked and in spring the vines plowed under

*of yield of corn in bushels per acre on vine plots compared in 1898 with no-legumes plot and in 1901 with plot where only pea stubble had been plowed under.*

Variety of cowpeas.	1898. Bus.	1901. Bus.
Wonderful (or Unknown) .....	2.7	0.6
Blackhawk .....	2.9	-1.5
Clay .....	4.3	0.7
Iron .....		-2.9
Clay .....		5.9
Clay .....		-3.2
Clay .....		0.6
Clay .....		1.9
Clay .....		5.3
Clay .....		6.8
Clay .....	3.3	1.4

The figures are given merely as a matter of record, no conclusions are yet warranted. As a matter of common experience any variety of cowpeas affords vines as much or more nitrogen than the following crop can utilize. For crops requiring a larger supply of nitrogen or for larger supplies of vegetable matter we may safely value the numerous varieties of cowpeas in proportion to the yield of hay which they afford if thus utilized. As noted in Bulletin 118 the Wonderful (or Unknown), Clay, and Iron are among the varieties making large yields of hay, and hence of good feeding material. The Wonderful, by reason of its large yield, large stems and roots, and varied usefulness is especially recommended for fertilizing purposes.

It is possible, however, that future investigations may show some advantage for varieties that run along the ground and thus by the tangle of runners hold the ground in winter a larger proportion of the leaves than is done by an erect variety like Blackhawk or Wonderful.

# COWPEA VINES, EFFECT ON FOLLOWING COTTON OF 1899.

On a reddish loam upland soil of fair quality Wonderful cowpeas and cotton, similarly fertilized, were grown in 1898. The peas were picked, yielding 10 bushels per acre, and the vines were plowed under in next spring, when both areas were planted with cotton. The corrected yield of cotton in 1899 was 10 pounds, or 32 per cent. greater on the area where cowpeavines had been plowed in than on the plots where the preceding crop had been cotton.

*Cowpea vines, residual fertilizing effect on crop, viz., oats grown in 1900.*—Burt oats were sown in February, 1900, on the same plots as above to test the residual or second-year effects of cowpea vines. On some plots the oats received no nitrogenous fertilizer, on others 76 pounds of nitrate of soda was used per acre.

The yields of oats, in bushels per acre, were as follows:

*Fertilizing effects on oats of cowpeas grown two years before.*

	After cotton in '98 and '99	After cowpeas in '98 & cotton in '99.	Increase able to be of
	Bus.	Bus.	Bus.
Yield of oats per acre with nitrate of soda..	19.7	25.5	5.8
Yield of oats per acre without nitrogenous fertilizer .....	12.3	22.0	9.7

In this case we have an increase of 9.7 bushels per cent., as the effect of cowpea vines on oats as the second crop after cowpeas. So strong was

ing effect of cowpeas that it was not entirely  
ed even when nitrate of soda was also employed,  
crease in the yield of oats under these conditions  
29 per cent.

*peas as fertilizer on lime land.*—A co-operative  
er experiment was conducted for this Station  
ot. A. A. McGregor on lime land at Town Creek,  
th Alabama. In his experiment the cowpea was  
rume employed.

898 cowpeas were grown on certain plots and cot-  
others. The cowpea vines, on which no fruit had  
ed, were plowed under in the spring of 1899.  
was planted on plots which had borne a crop of  
in 1898 and on others which had grown cowpeas  
ertilizing purposes. All cotton plots referred to  
s paragraph were unfertilized in 1899, and the  
ation of cowpeas and cotton in 1898 had been  
eal, only phosphate having been used with either

weather was exceedingly unfavorable in 1899, so  
e full measure of the fertilizing value of cowpeas  
ot revealed in this test.

his case the average increase in the yield of seed  
, which we may attribute to the cowpea vines is,  
nder very adverse conditions, 58 per cent., or 125  
s, worth at  $2\frac{1}{2}$  cents per pound, \$3.92 per acre.  
less later crops have also been benefited by the  
ation with cowpeas.

re is reason to expect a larger increase than the  
when cowpeas are plowed under on the lime lands  
er the Tennessee Valley or of the Central Prairie  
a of Alabama. Especially in the prairie soils the  
pal need is for vegetable matter to lighten the soil  
o add nitrogen, and for these purposes the choice  
usually be made between melilotus (the so-called  
) and cowpeas.



**FERTILIZING EFFECTS OF VINES OF COWPEAS AND V  
BEANS AS SHOWN BY SORGHUM IN 1897.**

In 1897 sorghum was grown on three plots following, respectively, velvet bean vines plowed under, cowpea vines plowed under, and fallow, or clean culture, without crop in 1896.

In 1897 the yields of sorghum hay per acre were as follows:

	Yield. Lbs.	Increase Lbs.
After fallow .....	3,792	
After cowpeas, plowed in .....	7,008	3,216
After velvet beans, plowed in.....	7,064	3,272

The effect of the legumes was to nearly double the crop of sorghum hay.

**FERTILIZING MATERIALS IN LEAVES, STEMS, AND  
OF THE COWPEA.**

In September, 1899, just 81 days after the planting of the seed, samples were taken of six varieties of cowpeas growing in 34-inch drills on poor gray sand. The sample in each case comprised the entire growth of a measured area of land, including the roots growing in the upper 6 inches of soil, which stratum contained nearly all the roots.

After curing, the leaves, blooms and pods, stems, fine stems (including runners, leafstalks, fallen leaves and leafstalks, and roots with attached stubble about two inches long, were carefully separated. Analyses were made in the chemical department of the University of Alabama, a composite sample representing all six varieties, the material analyzed being extremely dry. (For analyses of the same samples showing food value see Alabama Agricultural Bulletin No. 118, page 37.)

The following table shows what percentage of the air-dry weight of the plants of each variety was available for fertilizing purposes after the removal of hay.

*cent. of the entire weight of the cowpea plant in stubble and roots and in fallen leaves and leaf stalks.*

Variety.	Fallen leaves, etc.	Roots and 2-inch stubble.	Total.
	%	%	%
.....	17.7	25.0	42.7
poorwilli .....	3.7	21.6	25.3
.....	15.4	19.0	34.4
erful .....	19.2	20.3	39.5
White .....	14.3	14.5	28.8
.....	22.9	26.0	48.9
age, 6 varieties .....	15.5	21.1	36.6

The average for the six varieties shows that in each pound of dry plants there were 15.5 pounds of leaves and leaf stalks, and 21.1 pounds of roots and stubble, making a total of 36.6 pounds, more or less than one-third of the entire plant being thus left on the ground for fertilizer after the hay was cut.

Analyses of the different parts of the plant made by Mr. C. L. Hare, of the chemical department of this station, are recorded in the following table.

*Composition of parts of the air-dry cowpea plant.*

	Water.	Nitrogen.	Phosphoric Acid.	Potash.
	%	%	%	%
s .....	10.65	3.59	.78	1.49
stems .....	8.97	1.90	.64	.68
e stems .....	8.47	1.51	.42	1.49
n leaves and leaf stalks	9.75	1.67	.37	1.09
and 2-inch stubble..	5.25	1.38	.26	1.11

Let us direct our attention to the nitrogen, since this is the only one of the three precious elements that the plant obtains (in part) from the air, and the only one in

which the soil is enriched by the growing of cowpeas. The growing leaves in the air-dry condition contain nearly twice as large a percentage of nitrogen as the fine stems, and more than twice as much as the coarse stems and roots and fallen material.

*Amounts of air-dry material and nitrogen afforded by different parts of the cowpea plant on one acre (average of six varieties)*

	Air dry material.	Nitrogen
	Lbs.	Lb.
In leaves retained on vines .....	501.0	
In fine stems .....	401.6	
In coarse stems .....	438.8	
In pods, blooms, etc .....	325.0	
In fallen leaves and leaf stalks .....	357.3	
In roots and 2-inch stubble .....	411.7	
Total.....	2435.4	

\*Assuming 3% of nitrogen in thoroughly air-dry pods.

The amount of nitrogen stored up by a poor crop of cowpeas growing on an acre, 53.67 pounds, is equivalent to that contained in 767 pounds of cotton seed meal. It should be remembered that an undetermined portion of this nitrogen came from the soil, though on a soil as poor as this the nitrogen derived from the air probably constituted by far the larger portion of the total nitrogen utilized by the plant.

In the stubble, roots, and fallen material there were 11.65 pounds of nitrogen per acre or the same amount as is contained in 162 pounds of cotton seed meal.

Of the total nitrogen in the entire plant 22 per cent was found in the roots, stubble and fallen material.

An experiment somewhat similar to the preceding was made in 1900, using only a single variety, Wonder or Unknown. The seed were planted in drills

on poor gray sandy soil. Four samples were from two plots, each sample consisting of the growth on an area of four square yards; the samples were obtained by digging and sifting the soil to a depth of six inches, to which stratum all the principal roots were apparently confined.

The samples were accurately taken as indicated by the close agreement of the duplicate samples; hence the average results are given below. The vines were cut, the fallen leaves and leaf stalks collected, and the stubble cut out on September 5. This was 106 days after planting on one plot and 78 days after planting on the other.

The more mature sample was slightly less prime for hay, as shown by the unduly large amount of fallen leaves, while the other sample was too immature and succulent for easy curing.

The yields per acre of extremely dry hay according to the samples taken after being stored in an open place for seven months, were 2,269 pounds on the plot at the late stage, and 2,087 pounds of the less mature sample.

These are equivalent to about  $1\frac{1}{4}$  and  $1\frac{1}{8}$  tons of cowpea hay with the usual amount of mois-

*(air-dry) per acre of hay, roots, and stubble, and fallen leaves of the cowpea.*

	Air dry material, per acre.	
	Ripening stage.	Blooming stage.
	Lbs.	Lbs.
Adding stems, leaves, pods, etc.	2,269	2,087
Stubble about 2 in. long...	714	502
Leaves and leaf stalks .....	1,385	804
.....	4,368	3,393

The following table shows what proportion of the entire plant consisted of roots, fallen material, and hay in the plants harvested when ripening or when in bloom.

	Ripening stage.	Blooming stage.
	%	%
Tops .....	52	61
Roots and stubble .....	16	15
Fallen leaves, etc .....	32	24

When hay was made of cowpeas past their prime there was left on the ground in roots, stubble, and fallen material 48 per cent. of the weight of the plant, and when mowing occurred when the vines were in bloom 39 per cent. of the total weight remained as fertilizer material.

Analyses made by Prof. J. T. Anderson, Associate Chemist of this Station, are recorded below:

*Composition of hay, fallen material, and roots and stubble of the cowpea.*

	Water.	Nitrogen.	Phosphoric Acid.	Potash.
<i>In ripening stage:</i>	%	%	%	%
Hay .....	9.05	2.46	.85	2.1
Fallen leaves and leaf stalks .....	7.80	1.83	.64	1.1
Roots and stubble ..	7.77	1.17	.48	1.1
<i>In blooming stage:</i>				
Hay .....	8.15	2.57	.81	2.1
Fallen leaves, etc. ..	6.80	1.36	.59	1.1
Roots and stubble ..	7.00	1.05	.41	2.1

From this table it may be seen that the hay is more than twice as rich as the roots and stubble in nitrogen and also richer in phosphoric acid and potash.

The amounts of nitrogen contained in the hay, fallen material, and roots and stubble on one acre were as follows:

	Ripening stage. Lbs. nitrogen.	Blooming stage. Lbs. nitrogen.
y .....	55.8	53.6
len leaves, etc .....	23.1	10.9
ts and stubble .....	8.3	5.3
al per acre .....	87.2	69.8

The total amounts of nitrogen stored up by the cowplant on one acre was in one case 87.2 pounds, in the other 69.8 pounds, equivalent, respectively, to the nitrogen in 1,246 and 997 pounds of cotton seed meal.

At this amount there was left in and on the soil when ripening occurred late 31.4 pounds of nitrogen; and from younger plants 16.2 pounds per acre. This is equivalent to the statement that the nitrogen per acre remaining after the vines were removed was equal to the amount contained in 446 or 231 pounds of cotton seed meal.

Of the total nitrogen in the plant, the roots, stubble, and fallen material contained 34 per cent. at the ripening stage, and 23 per cent. at the blooming period.

Considering the three tests together the total amounts of nitrogen per acre of cowpeas was 70.2 pounds in the early growth, of which the average amount in the stubble was 19.75 pounds, or 28 per cent.

#### COWPEA STUBBLE VERSUS COWPEA VINES AS FERTILIZER FOR CORN IN 1901.

Corn was grown in 1901 on sandy loam land, which, in 1900 had borne a light crop of drilled cowpeas, and was left after the removal of the oat crop of 1900.

Three plots were employed. On one the cowpeavines had been cut the previous September, yielding 1,648 pounds of hay per acre. On the other two plots no vines nor cowpeas were harvested but the entire growth, which was

only about half of a normal yield, was plowed under March 14, at which time the stubble plot was also plowed.

On the stubble plot and on one of the others corn was fertilized with 100 pounds of acid phosphate per acre, which fertilizer was omitted from the third plot. The stand was uniform. The yields of corn in bushels per acre were as follows:

Pea stubble and phosphate as fertilizer .....	Bu.
Pea vines and phosphate as fertilizer .....	11
Pea vines as fertilizer, no phosphate .....	20
	23

The yield of corn following pea vines was 78 per cent greater than the yield on the plot where the stubble only had been plowed under, the increase being 8 bushels per acre.

In the presence of a considerable amount of rich vegetable matter furnished by pea vines, phosphate was not needed on this soil where acid phosphate had been applied annually for many years.

In a different field on more permeable gray sand soil corn grown in 1901 on a plot where the stubble Wonderful cowpeas had been plowed under for 1 year yielded 25.3 bushels per acre. The average yield of corn on two adjacent plots—where cowpea vines of varieties Lady and White Giant, both luxuriant growers had been plowed under, was 25.9 bushels per acre. Here there was practically no superiority of vines over stubble as a fertilizer for corn.

Note should also be taken of the increase in the corn crop due to plowing in either stubble or vines of a number of varieties as recorded in the table on page 131.

# VELVET BEAN STUBBLE AND VINES AS FERTILIZERS FOR CORN IN 1901.

The fertilizing effect of velvet bean stubble, of velvet bean vines, and of velvet bean vines in connection with phosphate, was tested in 1901 on four plots of very deep white sandy soil. On one plot the previous crop had been corn. On the other three plots drilled velvet beans planted June 13, after the harvesting of the corn crop, had made only a moderate growth in 1900. On one of these plots the velvet bean vines were cut in November 10, 1900, yielding 3,632 pounds of hay per acre.

On the other two plots the vines were left on the land over the winter. In the latter part of the winter all four plots were plowed, a disc harrow having first been run over the field while the vines were frozen in order to break them and thus render it easier to plow them in.

The corn on three of the plots was fertilized with 100 pounds of acid phosphate per acre, but this fertilizer was omitted on one of the plots where velvet bean vines had been plowed in.

*Yield of corn in 1901 following corn, velvet bean stubble, or velvet bean vines.*

	BUS.
acid phosphate (but no legume), as fertilizer.....	13.58
velvet bean stubble and phosphate as fertilizer..	17.93
velvet bean vines and phosphate as fertilizer...	25.90
velvet bean vines (no phosphate), as fertilizer..	21.48
per cent. increase in yield per acre, as compared with the yield on the plot on which the previous crop had been corn, was 4.35 bushels, or 32 per cent., with velvet bean stubble, and 12.32 bushels, or 81 per cent., with velvet bean vines.	



The increase attributable to 100 pounds of acid phosphate was 4.42 bushels, which made the use of mineral fertilizer decidedly profitable for corn on poor white sandy soil, when used in connection with large mass of rich vegetable matter. On the other hand, on a spot about 100 yards distant, where soil was less sandy and in better condition, phosphate did not increase the yield of corn when added to vines plowed under. (See page 140.)

IMMEDIATE FERTILIZING EFFECT ON SORGHUM OF CORN  
AND VELVET BEAN VINES AND OF COWPEA AND  
VELVET BEAN STUBBLE.

The soil on which the following experiment was made is a sandy loam, containing many small flint stones and underlaid by a stiffer subsoil.

In 1898 eight uniform plots were planted, 2 with velvet beans, 5 with Wonderful cowpeas (all plots broadcast), and 1 with drilled Orange sorghum. The growth of the several plots was either cured for hay or used as a fertilizer, as indicated in the next table.

March 9, 1899, all plots were plowed and in due season sorghum was planted in drills on all plots, and the cuttings of this crop at the proper season were cured for hay.

The yields per acre of sorghum hay at two cuttings, the first growth having become too coarse, but the second being of good quality, averaged as follows:

*First year effects on sorghum of stubble or vines of corn, cowpeas or velvet beans.*

	Yield per acre.	Increase legume
	Tons.	Tons.
Sorghum hay after sorghum stubble..	3.65	
Sorghum hay after cowpea stubble..	5.66	2.01
Sorghum hay after velvet bean stubble	5.80	2.15
Sorghum hay after cowpea vine, pckd	5.72	2.07
Sorghum hay after velvet bean vines	6.76	3.11

fertilizer for sorghum velvet bean vines proved to cowpea vines, and to velvet bean stubble. Stubble of cowpeas and of velvet beans was of nearly equal fertilizing value.

*fertilizing effect of legumes on corn grown as second crop after cowpea and velvet bean vines on cowpea and velvet bean stubble.*

On July 17, 1900, the sorghum stubble in the experiment discussed was turned with a one-horse plow and 29 corn was planted on all plots.

*Increasing effects in 1900 of stubble and vines of cowpeas and velvet beans grown in 1898.*

Corn in 1898.	Portion used for fertilizer.	Corn per acre in 1900.		
		Yield.	Increase over sorghum plot of 1898.	Increase, vines over stubble.
		<i>Bus.</i>	<i>Bus.</i>	<i>Bus.</i>
Sorghum. . .	Stubble. . . . .	24.1	.....	.....
Cowpeas. . . .	Stubble. . . . .	25.7	1.6	.....
Cowpeas. . . .	Vines, after picking	27.7	3.6	2.0
Velvet beans. .	Stubble. . . . .	23.9	0.2	.....
Velvet beans. .	Entire growth. . . .	26.8	2.6	2.4

It may be noted that the heavy growth of sorghum in 1898 did not utilize all of the fertility derived from the second crop of legumes. Although sorghum is a plant especially exhaustive to soil fertility, there still remained for the corn crop of 1900 a residue of nitrogen from the cowpea and velvet bean vines of 1898 sufficient to increase the yield of corn to the extent of 3.6 bushels per acre where cowpeas had grown two years before, and 2.4 bushels where velvet beans had grown. This is an increase of 3.2 bushels per acre as the residual fertilizing effect of these legumes.

The fertilizing effects of the stubble and roots of these two plants was far more transitory, the first succeeding crop, sorghum, practically exhausting the soil, leaving sufficient in the soil to increase the corn crop of 1900 by only an inconsiderable amount, viz.: 1.6 bushel and .2 bushel, an average of .9 bushel per acre." (Fr. Bulletin No. 111, Alabama Experiment Station.)

#### IMMEDIATE FERTILIZING EFFECT ON CORN IN 1900 OF COWPEA AND VELVET BEAN VINES.

This experiment was made on a white, sandy soil poorer than that used in the last mentioned experiment.

In the late spring and early summer of 1899 velvet beans had been planted in drills on certain plots and beggar weed had been sown broadcast on others. The beggar weed and a portion of the velvet beans was used exclusively for fertilizer. On other plots velvet beans were cut, thus leaving only the stubble as fertilizer for corn.

"These various fertilizing materials were all plowed under March 31, 1900, and Mosby corn planted April 5, using per acre 240 pounds of acid phosphate and 100 pounds of muriate of potash.

#### *Vines versus stubble of velvet beans as fertilizer for corn in 1900.*

Plots.	Material used for green manuring.	Yield of corn per acre.	Increase over stubble plot.
		Lbs.	Bush.
4 & 9	Stubble of velvet beans .....	15.6	
3 & 8	Entire growth of velvet beans .....	27.5	11
2 & 7	Entire growth of beggar weeds .....	18.7	3

entire growth of velvet beans afforded a yield of greater by 11.9 bushels per acre, or 76 per cent., the yield where only the stubble was employed as fertilizer." (Alabama Station Bulletin No. 111.)

*Individual fertilizing effects of velvet bean vines and stubble on the second crop of corn grown in 1901.*

The same poor, white, sandy hilltop was again planted in corn in 1901 without any nitrogen-fertilizer. The yield of corn per acre were 15 bushels where velvet bean vines growing in 1899 had been plowed under and only 11.1 bushels where velvet bean stubble had been turned under at the same time. The residual or second-year fertilizing effect of the vines was greater than that of the stubble by 3.9 bushels per acre or 33 per cent.

The total fertilizing value of the vines during the two seasons following the date when they were plowed in was equalled that of the stubble to the extent of 59 per cent., or 5.8 bushels of corn per acre. This amount of corn could usually be worth more than the net value of the 100 pounds of velvet bean hay obtained from the stubble plot at considerable expense for curing.

In this case it was more profitable to plow under velvet bean vines for fertilizer than to harvest them for hay.

Judging from other corresponding tests it would have been still more profitable to have grazed cattle on the vines, either in their green or winter-killed condition.

#### COWPEA AND VELVET BEAN VINES, IMMEDIATE FERTILIZING EFFECTS ON COTTON GROWN IN 1899.

In 1898 on a reddish loam soil, abounding in flint and underlaid by a red loam subsoil there were grown on adjacent plots cowpeas, velvet beans, and cotton.

ton, all fertilized alike with acid phosphate and kainit. The cowpeas and velvet beans were planted thickly in drills, using per acre 112 pounds of cowpeas and 96 pounds of velvet beans. The variety of cowpeas used was the Unknown or Wonderful. Both cowpeas and velvet beans were picked and removed from the field though the latter did not fully mature. The vines were turned under in March, 1899, and all plots were planted to cotton; each plot of cotton was fertilized at the rate of 240 pounds of acid phosphate and 96 pounds of kainit per acre.

The yield of seed cotton per acre in 1899 was 1,373 pounds following cowpeas, 1,373 pounds following velvet beans, and 837 pounds following cotton.

These figures show that the increased yield of seed cotton attributable to manuring with cowpea vines was 696 pounds per acre; the gain apparently due to fertilization with velvet beans was 546 pounds per acre. In percentages the increase is 83 and 64 per cent., respectively. Valuing seed cotton at  $2\frac{1}{2}$  cents per pound (which is equivalent to  $6\frac{3}{4}$  cents per pound of lint or \$7.50 per ton of seed), the gain with cowpeas and velvet beans is worth, respectively, \$17.40 and \$13.65 per acre.

Surely it was more profitable to grow cotton every alternate year at the rate of a bale per acre than to grow continuous cotton crops of about one-half bale per acre. Additional proof of this is found in the fact that one of these plots afforded in 1898 a yield of  $18\frac{1}{2}$  bushels of cowpeas per acre, besides increasing the cotton crop of the following year to the extent of \$17.40 per acre.

*fertilizing effects of cowpeas and velvet beans  
sorghum, oats, and late sorghum grown as  
second, third and fourth crops after  
these legumes.*

same plots were planted with drilled sorghum  
any nitrogenous fertilizer in April, 1900; with  
without nitrogenous fertilizer in November,  
and again with drilled sorghum without any ni-  
trogenous fertilizers, July 18, 1901.

*g effects of cowpeas and velvet bean vines  
planted in 1898 on sorghum in 1900 and  
as a second crop in 1901.*

preceding crop.	Sorghum hay per acre, 1900.	Sorghum hay per acre. 1901.	Total increase after legumes.
	Tons.	Tons.	Tons.
1898 and '99 .....	5.1	1.0	
in '98 (picked), and			
'99 .....	8.1	1.5	3.5
as in '98, and cotton			
.....	3.2	1.6	3.7

Compared with the plot not recently in legumes the  
yield of sorghum hay per acre in 1900 from cowpeas  
two years before was 3 tons per acre, or 59 per  
cent. from velvet beans two years before the increase  
was 3.1 tons of hay, or 61 per cent.

Increased yield with late sorghum, which was the  
second crop after the plowing in of the vines of the  
first crop was, after cowpeas, .5 of a ton, and after velvet  
beans, .5 of a ton. In the two sorghum crops the total  
increase in yield attributable to legumes was, with cow-  
peas, 3.1 tons of hay, and with velvet beans 3.7 tons of  
hay per acre.

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Now let us go back a few months and note the yield of the oat crop coming between the sorghum crops in 1900 and 1901.

*Yield of oats in 1901 grown as the third crop after legumes.*

Preceding crops:	Yield, oats per acre.	Increase after legumes Bus.
Cotton in '98; cotton in '99; sorghum in 1900	Bus. 23.3	Bus. 3.2
Cowpeas in '98; do do	26.5	3.2
Velvet beans in '98; do do	37.2	13.9

The fertilizing effect of the legumes was apparent in the third crop after the legumes, the increase where cowpeas had once grown being 3.2 bushels of oats per acre, or 14 per cent. The increase where velvet beans had been is suspiciously large, and in subsequent calculations it will be assumed that the increase in the yield on this plot if not influenced by accidental conditions would have been no greater than that on the plot of cowpeas, viz., 3.2 bushels per acre.

*Financial results of using cowpea vines as fertilizer for cotton, sorghum, oats, and late sorghum.*

Let us convert these yields of cowpeas, cotton, sorghum, and oats into their money values to learn whether the introduction of cowpeas or velvet beans in the rotation has been profitable.

crops per acre in three years (1) following cotton and (2) following cowpea vines.

	Value of crops per acre in			
	1899.	1900.	1901.	Total for 4 crops in 3 years.
<i>Legume in 5 years:</i>				
7 lbs. seed cotton, at 2½c*	\$20.92			} \$69.93
1 tons sorghum hay, 7 per ton .....		\$33.02		
23.3 bus. oats, at 40c....			\$9.32	
1 ton sorghum hay .....			\$6.67	
<i>Cowpeas in '98, picked and plowed under:</i>				
533 lbs. seed cotton at .....	\$38.30			} \$112.90
3.1 tons sorghum hay....		\$54.00		
26.5 bus. oats, at 40c....			\$10.60	
2.5 tons sorghum hay ....			\$10.00	
In 3 years .....				\$42.97
Difference per year per acre				\$14.32

6¼ cents per pound of lint, and \$7.50 per ton of seed.

total value of the products grown in three years was \$69.93 on the plot where no legume had been grown for many years and \$112.90 per acre on the plot where one crop of cowpeas had been grown once in three years, and where the vines, after the picking of the cotton, had been plowed under at the beginning of the second period under consideration. The difference in value of the crops for three years is \$42.97; the annual difference is \$14.32 per acre in favor of the plot where cowpeas had been grown.

figures showing the financial advantages of using velvet beans for fertilizer during the same period nearly correspond with those for cowpeas that have been mentioned. This relation need not be repeated.

On the same land the plowing under of the vines of the velvet beans was exceedingly profitable. The



soil of these plots is a reddish, clayey loam, stiffer and probably more retentive of fertilizer nitrogen and humus than the greater portion of the soil on the Station Farm.

Lest any should misapprehend the lessons of this experiment it is necessary to state that at no time in the three-year period was any nitrogenous fertilizer applied to any crop on any of these plots, but that each crop was supplied with phosphate and potash.

The yearly application of cotton seed meal would have lessened the differences between the plots, as it has done in our unpublished rotation experiments, and would have made the advantage in favor of legumes less striking than in the exhibit above.

IMMEDIATE FERTILIZING EFFECTS ON COTTON OF VELVET BEAN VINES.

On poor soil at Auburn an effort was made in 1888 and 1899 to ascertain the manurial value of the vines and stubble of velvet beans.

In 1898 cotton was grown on certain plots and velvet beans on others. The fertilization of all plots in 1898 was not identical, but for a given fertilizer applied to cotton there was a plot of velvet beans receiving the same fertilizer. The velvet beans grew in drills  $3\frac{1}{2}$  feet apart; the vines formed a dense mat of vegetation, but did not mature seed. In March, 1899, velvet beans and cotton stalks were plowed in and soon afterwards the plots were fertilized alike with a mixture of 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre.

Russell cotton was planted in  $3\frac{1}{2}$  feet drills on the plots on April 21. From midsummer forward there was a remarkable difference in the appearance of the two

of plots, the cotton plants being much larger, and more luxuriant on the plots where velvet beans had grown the year before.

Yield of seed cotton per acre following velvet bean vines .....	1,578 lbs.
Yield of seed cotton per acre following cotton .....	918 lbs.

Increase from velvet bean vines.....	660 lbs.
--------------------------------------	----------

The average increase attributable to velvet beans used as fertilizer was 660 pounds of seed cotton per acre, a gain of 72 per cent. as compared with the average yield of plots where the preceding crop had been cotton. This is equivalent to 16 cents per pound of seed cotton (equivalent to 40 cents per pound for lint and \$7.50 per ton for seed). The increase is worth \$16.50 per acre.

#### *Residual fertilizing effects on corn of velvet bean vines.*

The residual, or second-year, effects were tested on plots planted on these plots March 29, 1900, without velvet bean fertilizer.

Where cotton had grown in 1898 the yield of corn in 1900 was 18 bushels per acre; on the next plot, where velvet beans had been grown for fertilizer in 1898, the yield of corn in 1900 was 25.5 bushels. This gain of 7.5 bushels per acre, or 42 per cent., represents the residual or second-year effect of using the entire growth of velvet beans as a fertilizer.

#### IMMEDIATE AND RESIDUAL EFFECTS OF VELVET BEAN STUBBLE ON COTTON AND CORN.

In the same field the velvet beans on one plot were cut for hay October 12, 1898. The stubble and roots

were plowed in at the same time as the vines on other plots referred to above.

Cotton on the plot where only roots and stubble were plowed in yielded in 1899 1,126 pounds of seed cotton per acre, an increase when compared with the plot where cotton had grown the previous year of 499 pounds, or 49 per cent.

Comparing velvet bean vines with velvet bean stubble the difference in favor of the vines was 452 pounds of seed cotton per acre in the first crop.

Corn in 1900 on this plot yielded 14 per cent., or 14 bushels per acre more than did corn on the nearest plot where in 1898 cotton instead of velvet beans were grown. As the stubble plot was slightly lower down the hillside we suspect that the increase was partly due to this disturbing condition and not wholly to the residual effects of the velvet bean stubble of 1898.

It was on this stubble plot that in 1898 the velvet bean hay (8,240 pounds per acre) contained 112.5 pounds of nitrogen and the roots and stubble and fallen leaves only 12.5 pounds of nitrogen per acre. (See Alabama Station Bulletin, No. 104, page 336.)

#### IMMEDIATE FERTILIZING EFFECTS OF COWPEAS ON OATS IN 1897.

"On sandy soil in 1896 several plots were sown broadcast with the Wonderful variety of cowpeas, and an adjacent plot was sown broadcast with German millet. The German millet was plowed under, as were also the cowpeavines, the peas having been previously picked.

February 18, 1897, Red Rust Proof oats were sown after the above mentioned crops, using in both cases 100 pounds of acid phosphate and 80 pounds of nitrate of soda per acre.

cowpeas the oat straw grew to be three to four  
taller than on the plot preceded by German  
millet. The yields were as follows:

*Following cowpeas and German millet, 1897.*

	Yield per acre.	
	Bus. Grain.	Lbs. Straw.
Cowpeas, vines plowed under.....	22.8	788
German millet, plowed under.....	12.4	559
Yield per acre .....	10.4	229

In this case cowpeas were more valuable than German millet as fertilizer for the following oat crop, the results being in favor of cowpeas being 10.4 bushels of grain per acre and 229 pounds of straw." (From Bulletin No. 95, Alabama Experiment Station.)  
This resulted in an increase of 84 per cent. in grain.

#### THE FERTILIZING EFFECT OF COWPEA AND VELVET BEAN VINES AND STUBBLE ON OATS IN 1898.

This experiment is described in the following quotation from Bulletin No. 95 of this Station:

On July 14, 1897, on poor sandy soil Wonderful cowpeas were sown on two plots, velvet beans on two plots, German millet on a fifth plot. A sixth plot was prepared but not fertilized but left without seed, to grow up with grass, poverty weed, etc. Cowpeas and velvet beans were sown in drills two feet apart, German millet broadcast. The millet was cut for hay July 16, yielding 994 pounds per acre. The cowpeas on one plot were cut September 10, yielding 11 bushels per

acre. Velvet beans did not mature seed.

On September 10, 1897, cowpeas on one plot and velvet

beans on one plot were cut for hay and the stubble plowed under. The vines of cowpeas on one plot and of velvet beans on another were also plowed under on the above mentioned date. Then oats were sown at a uniform rate on all four plots, also on the plot where the German millet stubble had been plowed under and on the one where crab grass and various weeds had just been buried by the plow.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

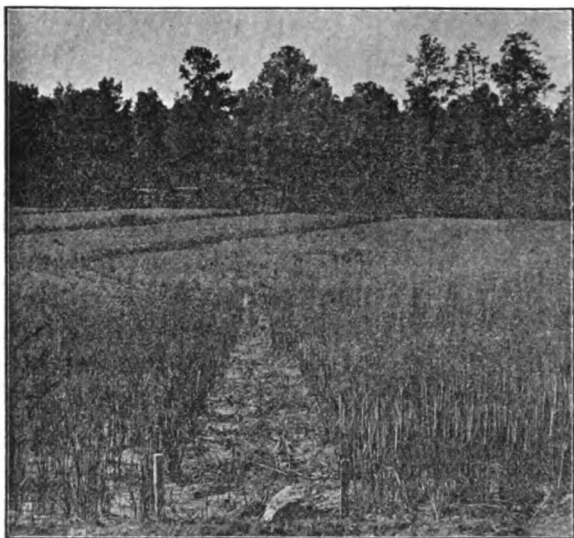


FIGURE 1. Oats following cowpea stubble on the right; on the left, oats after crabgrass.

acre of oats grown immediately after stubble  
vines of cowpeas, velvet beans, etc.

	Yield per acre.	
	Grain.	Straw.
	Bus.	Lbs.
velvet bean vines.....	28.6	1206
velvet bean stubble.....	38.7	1672
after velvet bean vines and stubble	33.6	1439
cowpea vines .....	28.8	1463
cowpea stubble .....	34.4	2013
after cowpea vines and stubble....	31.6	1738
crab grass and weeds .....	7.1	231
German millet .....	9.7	361
after non-leguminous plants.....	8.4	296

Early spring there was a marked difference in  
advance of the several plots, the plants being  
thinner and taller where either the stubble or  
cowpeas had been plowed under.

When the oats began to tiller, or branch, the differ-  
ence was marked, the plants supplied with nitrogen,  
the decay of the stubble or vines of cowpeas  
and velvet beans, tillering freely and growing much  
thicker than the plants following German millet or crab  
grass. The difference in the height and thickness of  
some of the plots is shown in figures 1 and 2.  
In 1898, oats on all plots were cut.

In the experiment the average yield of oats was 33.6  
bushels after velvet beans, 31.6 bushels after cowpeas,  
28.4 bushels after non-leguminous plants (crab  
grass and German millet.)

The gain of 24.2 bushels of oats and nearly  
one ton of straw as a result of growing  
oats after soil-improving plants, instead of non-  
improving plants, during the preceding season.

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Undoubtedly this is an extreme, and not an average case. If cotton seed meal, or other nitrogenous fertilizer, had been used on all the plots of oats, the plants on plots 2 and 5 would have made better growth, and the difference in favor of the leguminous plants would have been reduced.

A gain of five to fifteen bushels of oats per acre as a result of plowing under cowpea stubble or vines would make the growing of cowpeas for fertilizer a profitable operation, and it is far safer to count on such an increase as that obtained in our first experiment (11 bushels), rather than to expect such an exceptional increase as that obtained in this last experiment.

An unexpected result of this experiment is the larger crop on the plots where only the stubble was left than on those where the vines of cowpeas and velvet beans were plowed under. The plots were of nearly uniform fertility, as judged by the location and by the uniform growth of cotton on all plots in 1896. While admitting the possibility that the two west plots (plots 3 and 4) were slightly richer than the two on the east (plots 1 and 2), the writer thinks that the difference in yield was almost wholly due (1) to the fact that the vines (especially those of the velvet beans) were not properly buried by the small plow employed, and (2) to the fact that the seed bed for oats was more compact where the stubble was plowed under, a point of advantage, doubtless, in such a dry winter as that of 1897-98. It does not follow that the land will be permanently benefited by cowpea stubble to a greater extent than by cowpea vines. The reverse is probably true." (From Bulletin No. 95, Alabama Experiment Station.)

*fertilizing effect on late corn of cowpea and velvet bean vines and stubble.*

On June 20, 1898, or a month after the harvesting of the first crop in the last mentioned experiment, all six of the plots were planted in corn without nitrogenous manure, which crop, as usual with very late corn in this country, was a failure.

The results were as follows:

*Yield of late corn grown as the second crop after legumes.*

	Yield per acre.	Increase after legumes.
	Bu.	
Plowed in .....	4.3	
Velvet, stubble plowed in .....	7.3	
Stubble plowed in .....	6.2	.4
Velvet; stubble plowed in .....	7.7	1.9
Velvet; vines plowed in .....	6.7	.9
Velvet; vines plowed in .....	7.9	2.1

The fertilizing effects of both stubble and vines of the first crop was scarcely perceptible in the late corn eight months after and harvested thirteen months after the plowing under of the large amounts of manure furnished by the legumes. Apparently the reason there was not due to deficient rainfall, for this was the case except for about two weeks about the middle of June. The small size of stalks leads to the suspicion that there was a deficiency of nitrogen on all the plots, this nitrogen was lost by being leached out of the soil during water this loss must have occurred already after corn was planted or in July and August of 1898. In 1898 April, May, and June were unusually dry months. On the other hand there was an excessive rainfall July 4 to 11 and of still more excess July 28 to August 6. During this latter



period 7.59 inches of rain fell in a space of ten days.

The experiment seems to teach that on very gray, sandy upland, subject also to surface washing, the fertilizing effects of even large amounts of nitrogen furnished by preceding crops of legumes may be removed from the soil within twelve months after the legume has been plowed in. The lesson might also be drawn that on such soils the planting of any non-leguminous crop after small grain is risky, but that if such a crop is employed the seed should be put into the ground as soon as possible after the removal of the grain.

An experience like this in which the fertilizing effect of the entire or nearly entire growth of the legume was no greater than that of the stubble on either the first or on the second succeeding crop emphasizes the wisdom of utilizing the vines of cowpeas, etc., for leaving only the roots and stubble to fertilize the soil for the next crop.

#### IMMEDIATE FERTILIZING EFFECT ON WHEAT OF COWPEA AND VELVET BEAN VINES AND STUBBLE.

All the plots of the last mentioned experiment were in oats from February to June, 1900.

June 23, 1900, certain plots were planted with drilled cowpeas, certain others with drilled velvet beans, yet others were merely plowed and fertilized with minerals, as were the legumes.

Of the two plots of cowpeas, one was cut for hay yielding 2,004 pounds per acre; on the other 7.9 bushels of seed per acre were picked. One plot of velvet bean was cut for hay, while on the other the vines were left on the ground for fertilizer. The cowpea plants, variety Wonderful, were somewhat injured by a fungal disease of the roots; velvet beans, by reason of late

planting and deficiency in stand, did not make an entirely satisfactory growth.

November 9 all plots were plowed, turning under either volunteer grass and rag weeds, or cowpea vines, or velvet bean vines, or cowpea stubble, or velvet bean stubble. The plowing was poorly done with a one-horse turn plow and in sowing the wheat a few days later some of the velvet bean vines were pulled up. The wheat received only mineral fertilizers, and, indeed, practically no nitrogen had been applied to these plots for three years.

The yields of wheat in 1900 were as follows:

*Bushels of wheat per acre after leguminous and non-leguminous crops:*

Crop in 1899.	Yield per acre.	Increase by use of legumes.	
		Bus.	%
Volunteer grass and weeds; plowed in .....	3.1		
Cowpeas; stubble plowed in .....	11.8	8.7	280
Velvet beans; stubble plowed in .....	7.8	4.7	151
Cowpeas, plowed; vines plowed in ....	9.0	5.9	190
Velvet beans; vines plowed in .....	8.5	5.4	174

Both the stubble and the vines of the legumes practically trebled the yield obtained on the plots where no legume had grown. The stubble was at least as effective as the vines, pointing to the greater economy of utilizing the vines for hay or pasturage.

June 19, 1900, all these plots were planted with Moscow corn, fertilized only with phosphate and muriate of potash. The crop was a failure on all plots, the yield secured fodder corn ranging from 1,540 to 2,200 pounds per acre, the plots where vines had been plowed in the previous fall showing no superiority over the stubble plots, and very little increase as compared with the plot where no legume had grown. It is impossible to ascertain whether the failure with corn was due to the

protracted drought during almost the whole of July and to the leaching out of the nitrogen of the legumes during the last few days in June, when 5.20 inches of rain fell within a period of four days. The latter explanation seems more probable in view of the, fairly favorable rainfall after August 1, 1900, and because of a similar failure of the late corn crop on the same field in 1898, when there was no long period of drought, but a brief one of even more excessive rainfall.

The history of these six plots for these four years ending with 1900 as just detailed shows very plainly that the fertilizing effects of nitrogen very quickly disappeared on this light sandy sloping field, not underlain by a clay or clayey loam subsoil; and that on such soil the stubble of cowpeas or velvet beans was as efficient as the vines, not only for the immediately succeeding crop, but for later crops as well. This narrative should add force to the recommendation we have so often given that as far as possible the stems, foliage and seed of legumes be utilized as food for animals and only what remains be employed as fertilizer.

#### FERTILIZING EFFECTS OF VELVET BEANS, AND PEANUTS AS COMPARED WITH CORN, SWEET POTATOES AND CHUFAS.

On a gray sandy upland soil, free from stones and underlain by a sandy subsoil, various crops were grown in 1899, for the double purpose of comparing them as to the amount of hog food produced and as to their effects in enriching or depleting the soil. The chufas and a part of the Spanish peanuts were consumed by shoats penned on the field. As the running variety of peanuts failed this season to make any nuts the luxuriant growth of vines was plowed under in the fall as was also done with the vines of velvet beans and with

es after the latter had been picked. Only corn were removed from the land, and only sweet potatoes.

n broadcast on November 13, 1899, on all employed as the crop for determining what various summer crops had exerted on the the soil. The fertilizer for rye consisted of g amounts per acre:

ds of cotton seed meal.

ds of ammoniated acid phosphate.

ds of muriate of potash.

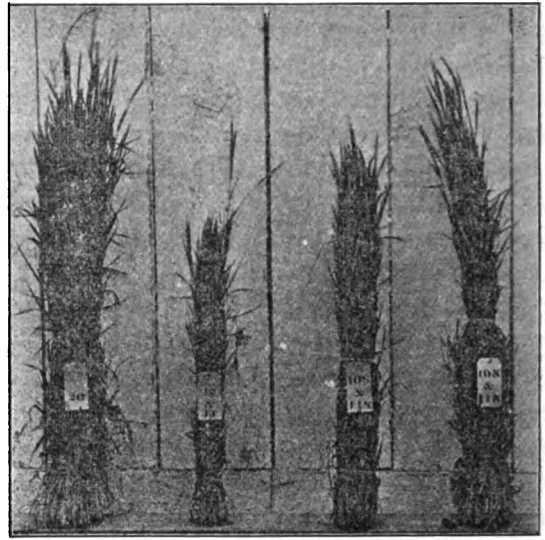
ts of the legumes as fertilizers for rye would more striking if no cotton seed meal or am- mano had been employed, but the poverty of soil made some nitrogen indispensable if ab- re of crop was to be avoided on the plots t potatoes, chufas and corn had grown.

as cut April 13 and April 16, and the green ce weighed. No second cutting of rye was he land was turned to other uses.

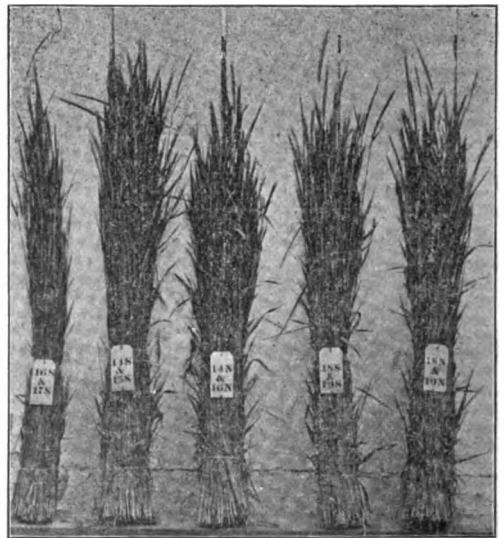
*ye following sweet potatoes, corn, chufas, eanuts, cowpeas and velvet beans.*

Preceding crop.	Yield per acre.	Increase from legumes as compared with sweet potatoes.	
		Lbs.	%
et potatoes dug (av. 2 plots) ..	2360		
n, ears pulled .....	3440	1080	41
ufas, eaten on the land.....	4560	2200	93
anish peanuts; dug and only .....			
ed .....	3440	1080	41
nish peanuts; eaten on the land .....	6640	4280	181
ippoowill cowpeas, drilled and .....			
ased) .....	4960	2600	110
et beans, entire growth plowed .....			
ts) .....	5720	3360	142
et beans, nearly mature pods .....			
s plowed in .....	4720	2360	100
anning peanuts, entire growth .....			
av. 2 plots) .....	5212	2852	121

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**FIGURE 2.** Rye from equal areas, following (20 velvet beans; (12 & 13) sweet potatoes; (10 S & 11 S.) corn; (10 N. & chufas hogged



**FIGURE 3.** Rye from equal areas, following (16 S. & 17 S.) S. peanuts, dug; (18 S. & 19 S.) cowpeas; 14 N. & 15 N.) r. peanuts.

ness increased the yield in every case as compared with sweet potatoes, the excess ranging from 41 to 100 per cent. Among the non-leguminous plants sweet potatoes was most exhausting to the soil, and when consumed on the land, the least. This is a common observation. In this case the effects of the sweet potatoes were not due to the disturbed soil, for all plots were plowed and the potatoes were dug.

With the legumes the greatest increase, 181 per cent, was obtained on the plot where Spanish peanuts were consumed on the land by hogs. Since the consumption of peanuts here was not excessive, since the growth was only moderate, and since the vines of Spanish peanuts on an adjoining plot did not greatly increase the yield, we can attribute the increase where hogs grazed, only to an assumed quicker nutrification of the material that had passed through animals. This lends further support in the fact that chufas consumed by hogs on the land left the soil in better condition than did either corn or sweet potatoes.

For the entire growth of the several legumes consumed on the land, with or without being utilized as feed, the succeeding yield of rye was more than

that obtained when rye was grown in 1899 on a plot adjacent to the cotton. The rye following cotton yielded 5,560 bushels per acre, but it is not fair to compare this yield with that following the legumes, because the cotton was very heavily fertilized, and some of this fertility probably remained in the soil to be utilized by

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*Fertilizing effects of legumes on sorghum grown as second crop.*

To ascertain what differences still existed in the as a result of legumes grown in the summer of 1899, sorghum was sown in drills on this same field June 1900, all plots being uniformly fertilized with a phosphate. So that sorghum thus becomes the second crop after the various legumes, and is intended to reveal the residual or "left over" effects of the summer crops of 1899.

*Residual fertilizing effects on sorghum, of peanuts, cowpeas and velvet beans.*

Preceding crops.		Yield sorghum hay per acre.	Increase from summer crops with sweet potatoes
Summer of 1899.	Winter, 1899, 1900.		
Sweet potatoes, dug .....	Rye	Lbs. 5360	Lb.
Corn, ears pulled .....	Rye	5760	4
Spanish peanuts, dug; nuts removed.....	Rye	4480	los
Spanish peanuts; eaten on land .....	Rye	4000	los
Cowpeas, picked .....	Rye	5760	4
Velvet beans, all plowed in.....	Rye	7110	17
Velvet beans, pods picked .....	Rye	7600	22
Running peanuts, all plowed in.....	Rye	6320	9
Cotton, heavily fertilized .....	Rye	4000	los
Av., potatoes, corn, cotton .....	Rye	5040	
Av., velvet beans, cowpeas, running peanuts	Rye	6697	16

Evidently rye had not exhausted all the fertilizing value of the legumes. This second crop was favorably affected by all the legumes except by Spanish peanuts, the benefits of which had disappeared. The average increase on the plots where all the other legumes had been grown the preceding summer was 33 per cent. as compared with the yield on the plots where corn, cotton and sweet potatoes had constituted the summer crops of 1899.

# RELATIVE FERTILIZING VALUES OF THE COWPEA AND VELVET BEAN.

When tested on a number of crops, each grown *immediately after* the legumes, the percentage increase as compared with corresponding plots that had borne no manure was 128 per cent. from peavines, and also 128 per cent. from velvet bean vines. Additional weight is added to these figures since they represent the average of six tests with each plant. Continuing the inquiry as to their comparative value, we find that the second crop after cowpea vines showed an increase of 37 per cent. and the second crop after velvet bean vines an increase of 38 per cent. This is the average result of two comparable tests with each plant.

Comparing these two plants with reference to the fertilizing effect of the stubble on the first crop we find the average of three tests an increase that is practically the same for the two plants.

Combining the results for the vines of each legume as shown in the first and second succeeding crops with the immediate results from the stubble of each we must conclude that at Auburn the fertilizing values of the cowpea and velvet bean are practically equal. This is true for an acre of each. In the stubble plots the average yield of velvet bean hay has been the greater, that is 4,781 pounds per acre of velvet bean hay against 3,788 pounds of cowpea hay, so that apparently pound for pound the cured tops of cowpeas have been somewhat more effective than the vines of velvet beans. This is in practical accord with the results of chemical analyses made at this station by Dr. Anderson, who analyzed peavine hay and velvet bean hay from plots where the stubble was used as fertilizer. He found 2.29 per cent. nitrogen in velvet bean



vines and 2.46 per cent. of nitrogen in the cowpea vines, both samples containing 9 per cent. moisture. The nitrogen in the two stubbles was practically equal, 1 per cent.

Let us now consider the results as a whole, combining those for the two plants and assuming that the fertilizing value of cowpea vines and of velvet bean vines is equal, and that the stubble of the one plant is as effective as that of the other. In what follows the figures express the average results for cowpeas and velvet beans considered together under the name of summer legumes.

#### INCREASE IN THE FIRST CROP AFTER PLOWING IN THE VINES OF SUMMER LEGUMES.

With cotton as the first crop the increase in seed cotton per acre at Auburn was respectively 367, 546, 600 and 660 pounds of seed cotton per acre. This is an average increase of 567 pounds, worth at  $2\frac{1}{2}$  cents (equal to  $6\frac{3}{4}$  cents for lint, \$7.50 per ton for seed) \$14.17.

The yield of *seed cotton* following the vines of summer legumes exceeded that on plots where the preceding crop had been cotton to the extent of 32, 64, and 72 per cent. *The average increase in the yield of seed cotton attributable to the vines of the legumes was 63 per cent.*

With *corn* as the first crop, the increase per acre attributable to plowing in the entire growth of velvet beans was 81 per cent. or 12.3 bushels, worth, at 50 cents per bushel, \$6.15.

With *oats* as the first crop, the effect of the vines of the summer legumes is seen in an increase per acre of 10.4, 20.2, and 20.4 bushels respectively. The average

crease per acre was 17 bushels, worth at 40 cents per bushel, \$6.80. *The increase in the first crop of oats and summer legumes was 81, 240 and 242 per cent., an average of 189 per cent.*

With *wheat* the increase was 5.4 and 5.9 bushels, an average of 5.65 bushels per acre, worth at 80 cents per bushel, \$4.53. *The increment was 174 and 190 per cent. respectively, an average gain of 182 per cent.*

With *sorghum* grown as the first crop after the plowing under of the vines of cowpeas and velvet beans, the increase in hay per acre was 1.6, 1.6, 2.07, and 3.11 tons, an average gain per acre of 2.1 tons of hay, worth, at \$7 per ton, \$14.02. The percentage gains were 85, 86, and 86, respectively, *an average of 78 per cent.*

#### INCREASE IN THE FIRST CROP AFTER PLOWING IN THE STUBBLE OF COWPEAS AND VELVET BEANS.

With *cotton* the yield was greater after velvet beans than after cotton to the extent of 18 per cent., 108 pounds of seed cotton per acre, worth, at 24 cents per pound, \$5.20.

With *corn*, the stubble of velvet beans afforded a gain of 32 per cent. or 4.3 bushels, worth \$2.15.

With *oats* grown after the plowing in of the stubble of these summer legumes the increase was 30.3 and 26 bushels, or an average of 28.1 bushels per acre, worth \$2.24. This is an average gain of 334 per cent.

With *wheat* following the stubble of cowpeas and velvet beans the increase was 4.7 and 8.7, *an average of 6.7 bushels per acre, worth \$5.36.* The gain amounted to 151 and 280 per cent. respectively, an average of 215 per cent.

With *sorghum* the yield of hay was increased by the

stubble of the legumes to the extent of 2.01 and tons, an average of 2.08 tons of hay per acre, value \$13.87. *The average increase was 57 per cent.*

**WHAT CROPS WERE MOST FAVORABLY AFFECTED BY  
VINES OR STUBBLE OF COWPEAS AND VELVET BEANS**

The data in the following table answer this question.

*Increase in first crop attributable to vines or stubble of cowpeas and velvet beans.*

TEST CROP.	After Legume Vines.			After Legume Stubble.		
	No. of Tests	% Increase	Value of Increase	No. of Tests	% Increase	Value of Increase
Cotton . . . . .	4	63	\$14.17	1	49	
Corn.. . . .	1	81	6.15	1	32	
Oats.. . . .	3	189	6.80	2	334	
Wheat . . . . .	2	182	4.53	2	215	
Sorghum.. . . .	4	78	14.02	2	57	

The percentage increase attributable to either vines or stubble of cowpeas and velvet beans was greater with fall oats and wheat than with cotton, corn or sorghum. In other words, *the crop that was best adapted to utilize the nitrogen of the legumes was that which left the land unoccupied for the shortest time between the maturing of the legume and the beginning of the new growth.* Unpublished parallel experiments with hairy vetch employed as fertilizers confirm this latter conclusion. All the facts before us indicate that after the vines or stubble of a legume are plowed under in a sandy soil the seed of the succeeding crop should be planted before the lapse of many weeks. The early occupation of the soil by the young plants will serve to retain much nitrogen which would be leached out and carried away in drainage water if the ground should remain unoccupied for several months.

from what has just been said it should not be inferred that we are advocating the sowing of the small seeds or of any small seed immediately after plowing a large mass of vines. Instead, sufficient time should be given for the soil to become somewhat settled by the action of the rain or of harrow, drag, or roller. Small and still smaller seed can usually be sown after a shorter interval where the vines of the legume are utilized for hay or pasturage, leaving only the roots and stems to be incorporated, than where the entire crop of the legume is turned under in the fall for fertilizer.

Plowing under of cowpea vines takes place after the time as the mass of vegetable matter will have been so diminished and the stems so weak that the delay in sowing to permit of the compacting of the earth and the vegetable matter will be less necessary, or perhaps inadvisable. But this interval may be quite necessary with velvet bean vines at whatever time they are plowed under, for the mass of matter will be considerable and the material is apt to be buried in large

quantities. Referring again to the last table, we see that while small grains gave the largest percentage increase in value from the use of a preceding summer legume as fertilizer, the value of the increase was greatest with cotton and sorghum hay. In other words, *cotton made more profitable use of either the vines or stubble of the summer legumes on sandy land than did either corn, oats, or wheat.*

Sorghum responded freely to the abundant supply of nitrogen in the legumes, and it may be accepted as a thoroughly tested proposition that on poor or medium land any hay plant of the grass family will return a profit for a judicious application of nitrogen,

whether this be in the form of a preceding crop of peas, velvet beans, melilotus, hairy vetch, or crimson clover, or in an application of stable manure, cotton seed, cotton seed meal, or nitrate of soda.

#### ROTATION OF CROPS THE FIRST STEP IN SOIL IMPROVEMENT.

The general statement may be safely made that an ordinary crop (except peanuts, cowpeas and most other legumes) can usually be produced with far greater profit when it follows some leguminous plant than when its predecessor is some non-leguminous plant, as cotton, corn, the small grains, etc. It may also be added that many, if not most, poor tracts of land can be cultivated in the usual farm crops at a profit only when a legume is occasionally grown to supply the necessary nitrogenous vegetable matter, and improvement in texture and resistance to drought.

A more general use is urged of some rotation that requires all the cultivated upland of the farm to be planted to cowpeas or other soil-improving plant every second, third or fourth year or oftener. The growing of legumes constitutes the cheapest means of obtaining nitrogenous fertilizers, and on farms where a large proportion of the land is devoted to legumes, the fertilizer bills can be reduced by the discontinuance of purchases of cotton seed meal and by the substitution of high grade acid phosphate for the higher priced ammoniated guanos.

A highly satisfactory rotation for cotton plantations, which has been widely tested, consists of the alternation in the order named of cotton, corn, and one of the small grains, with cowpeas between the cotton rows and also immediately following the small grains. This three-year rotation gives one-third of the

ch year in cotton, the cotton immediately following cowpeas sown after small grain. One-half the total area can be devoted to cotton by a four-year rotation on this plan, as follows: Corn with cowpeas, small grain followed by cowpeas, cotton, and cotton.

#### THE AVERAGE IMMEDIATE FERTILIZING EFFECTS OF VINES AS COMPARED WITH STUBBLE OF COWPEAS AND VELVET BEANS.

Although in the last table a comparison of the percentage increase after vines with that after stubble is not strictly legitimate since the number of tests was unequal, yet that table throws some light on the matter.

A strictly accurate comparison of the fertilizing effects of vines and stubble as measured by the crop immediately following is shown below; in this table only those experiments are recorded where corresponding vine and stubble plots were under identical conditions of soil, date of planting, etc.

*Increased percentage of vine plots over stubble plots.*

	No. of tests.	%
with cotton as first crop .....	1	40
with corn do .....	4	49
with oats do .....	2	[31]*
with wheat do .....	2	[20]*
with sorghum do .....	2	9

\*Yield after legume stubble 31 and 20 per cent. respectively greater than after vines, the latter leaving the land too loose, a condition that could probably have been avoided by better preparation.

In the crop immediately following the legumes the vines afforded the larger yield except when accidental circumstances reversed this result with wheat and oats. This excess in the first crop due to plowing under the

vines was here considerable, but was it sufficient to make this method of disposing of the vines more profitable than to use them for hay?

Of the several factors on which the answer depends we will first consider the value per acre of the increase in the first crop immediately succeeding the legume, using the values for a unit of each crop heretofore assumed (see p....) and omitting results with small grains, for reasons given in the footnote.

*Average superiority of vines over stubble of legumes shown in first crop.*

	No. of tests.	Increase per acre.	Value of in- crease	% in- crease
With cotton as first crop. ....	1	452 lbs. seed cotton	\$11.30	40
With corn as first crop .....	4	6.6 lbs. corn.....	3.30	49
With sorghum as first crop...	2	.5 ton hay.....	3.34	4
Average in favor of vines over stubble .....			\$5.98	

The average increase of \$5.98 in the value of an acre of the first crop in favor of plowing in the vines compared with utilizing only the stubble for fertilization is evidently so low as to be much less than the value of the 4,030 pounds of legume hay per acre obtained from the stubble plots, which should be priced at not less than \$10 per ton. As a partial offset we must bear in mind that in four of the experiments in plowing under cowpea vines the peas were first picked, the average yield in these tests being 11.1 bushels per acre. There is no such corresponding offset with velvet beans, for the seeds usually do not mature in the latitude of Auburn.

If we value cowpeas at 50 cents per bushel, plus the cost of hand-picking, we have a second credit for the vines, the sum being \$5.55. Adding this to \$5.98, the

ra value of the first crop after vines, as compared with stubble, we have a total credit for the vines when used as fertilizer of \$11.53 per acre in comparison with the value of the cowpea and velvet bean hay when utilized as stock food. The average yield of cowpea hay from the stubble plots was 3,278 pounds per acre, and velvet bean hay 4,781 pounds, or a collective average 4,030 pounds of legume hay per acre. At \$10 per ton, this would be worth \$20.15 per acre. Subtracting from this, \$9.50 as above, we have \$8.47 as the difference in the *first year's profits* in favor of utilizing the vines as hay. However, other factors must be considered before we have satisfactorily determined whether it was most profitable to use the vines after picking the tops or to utilize the tops of both cowpeas and velvet beans for hay; chief among these factors are the relative residual fertilizing values of vines and stubble as shown by differences in the yield of the second and subsequent crops after legumes.

#### WHAT IS THE FERTILIZING EFFECT OF VINES AND STUBBLE OF COWPEAS ON THE SECOND CROP AFTER THE LEGUME?

The answer is found in the following table:

Average increase in second crop after legumes.						
After vines.				After stubble.		
No. of tests.	Amt. increase.	% increase.		No. of tests.	Amt. in-crease.	% In-crease.
corn .....	5	3.36 bus.	24	5	1.34 bus.	12
oats .....	1	7.75 bus.	54			
sorghum .....	4	2.15 tons	41			

In the second crop after the legumes there was in every case a considerable increase attributable to the use of the vines as fertilizer.



The fertilizing effect of the stubble as shown by the second crop of corn is much less than the increment due to the vines plowed under many months before.

There is a sixth test with corn not belonging in the preceding table, that gives additional data for a comparison of the second-year effects of vines with stubble. Combining the results of the six tests, we find that the corn grown as the second crop after legumes afforded a larger yield on the vine plots than on the stubble plots to the average extent of 2.1 bushels per acre, or 14 per cent.

#### THE DURATION OF THE FERTILIZING EFFECTS OF STUBBLE AND VINES OF COWPEAS AND VELVET BEANS.

The stubble of these legumes repeatedly exerted a slight effect on corn grown as the second crop, (the average of only one and one-third bushels per acre) that we may reasonably conclude that two crops mark the limit to which the benefits of legume stubble extend in cases where the soil is sandy and permeable as at Auburn. It is quite possible that the advantage from using stubble as fertilizer might have been slightly more enduring in a stiffer soil, but in no case can such a relatively small amount of vegetable matter and nitrogen afforded by the roots and stubble influence the succeeding crops more than a few years.

It is quite a different matter when the vines, representing the entire growth of the legume (except in some cases the pods) are plowed under. We have learned from the data in previous tables that the yield when the vines were used as fertilizer was in the first crop 63 to 189 per cent. greater than the yield of the corresponding crop immediately preceded by a non-leguminous plant; and that in the second crop the incre-

red from 24 to 54 per cent. The effect exerted by the  
s of the legumes on the third succeeding crop was  
ed in only one field, the increase in oats as the third  
after cowpea vines being 3.2 bushels per acre, or  
er cent. With sorghum planted in 1901 as the  
th crop immediately after the oats were cut, there  
a perceptible increase on the plots where the vines  
owpeas and velvet beans grown in 1898 had been  
red under; extremely unfavorable conditions and  
ial failure of late sorghum detract from the relia-  
y of the percentage figures for this, the fourth crop.  
three years or four crops the large mass of vines  
inued to exert some influence. This experiment was  
ducted on a soil of the stiffest type found on the  
on farm, which, however, is fairly permeable to  
er, and which might be described as a reddish loam  
aining an abundance of large flint stones.

e should expect an equal mass of leguminous vege-  
on employed as fertilizer on clay or prairie soils to  
cise a favorable influence for at least three years,  
robably for as long a period as do heavy applica-  
s of coarse stable manure. Local experiments to  
rmine the permanency of the action of the legumes  
greatly needed, and correspondence is invited from  
ies wishing to make such tests.

is our expectation to continue work along the lines  
ated in this bulletin, and it is highly desirable that  
e investigations should be extended to include soils  
character different from that at Auburn, though  
means of doing this in a thoroughly satisfactory  
ner are not now in sight.

a conclusion the writer would reaffirm his previous  
ement, made in Bulletin No. 107 of this station, as  
ws:

## A RATIONAL SYSTEM OF FERTILIZATION.

Considering permanency of effect, as well as influence on the crop immediately following, the cowpea and other leguminous plants must be ranked as a cheaper source of nitrogen than is any nitrogenous material which can be bought as commercial fertilizers. The aim of the cotton farmer should be to grow such areas of legumes which will enable him to dispense with the purchase of non-nitrogenous fertilizers for cotton, using the funds thus saved to purchase increased amounts of phosphates or other necessary non-nitrogenous fertilizers. The money which would have been necessary to purchase one pound of nitrogen will buy about three pounds of phosphoric acid or of potash, which larger purchases of phosphate or potash will enable the farmer to grow heavier crops of legumes. And heavier crops of legumes trap large amounts of otherwise unavailable atmospheric nitrogen and result in further soil enrichment.

In the writer's opinion *the most promising method of increasing the yield of cotton per acre and the profit of cotton culture is by a more general use of leguminous plants as fertilizers.* These invaluable allies are not so much as some farmers utilized and appreciated, but their use might be increased twentyfold with advantage to the current crop, to the permanent upbuilding of the soil, and to the filling of the farmer's pocket. It is put in the case very mildly to say that the average yield of cotton per acre in Alabama might be increased by at least fifty per cent. through the general use of legumes as fertilizers.

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APPENDIX. Condensed statement of effects of using cowpea and velvet bean vines or stubble as fertilizers at Auburn.

Legumes.	Vines or stubble.	Test crop.			Amt. per acre, increase.		Per cent increase.		Superiority of vines over stubble		Yield of legumes per acre.		Field.
		Plant.	1st or 2nd after legumes	Year grown	From vines.	From stubble.	From vines.	From stubble.	Am't per acre.	Per cent.	Lbs. hay.	Bus. cow-peas.	
Cowpea.....	V. & S.	Corn. ....	1st	'01	.....	.....	.....	.....	8 88	78	1648	.....	D
Cowpea.....	V. & S.	Corn. ....	1st	'01	.....	.....	.....	.....	.60	2	3920	.....	M
Cowpea.....	V.	Cotton ..	1st	'99	367	.....	32	.....	.....	.....	.....	11.8	D
Cowpea.....	V.	Oats.....	2nd	'00	5 8*	.....	29*	.....	.....	.....	.....	.....	D
Cowpea.....	V.	Oats.....	2nd	'00	9.7	.....	79	.....	.....	.....	.....	.....	D
Cowpea.....	V.	Sorghum..	1st	'97	1.6	.....	86	.....	.....	.....	.....	.....	F
Velvet bean....	V.	Sorghum..	1st	'97	1.6	.....	85	.....	.....	.....	.....	.....	F
Velvet bean....	V.	Corn. ....	1st	'01	12 3	.....	81	.....	5.0	28	3632	.....	D
Velvet bean....	V. & S.	Corn. ....	1st	'00	.....	4.3	.....	32	.....	.....	.....	.....	D
Velvet bean....	V. & S.	Corn. ....	2nd	'00	.....	.....	.....	.....	11 9	76	2800	.....	D
Velvet bean....	V. & S.	Sorghum..	1st	'99	2.1	.....	57	.....	3.9	33	.....	.....	D
Cowpea.....	V.	Sorghum..	1st	'99	.....	.....	.....	.....	0.1	1	.....	13.6	T
Cowpea.....	S.	Sorghum..	1st	'99	.....	2 0	.....	55	.....	.....	6400	.....	T
Velvet bean....	V.	Sorghum..	1st	'99	3.1	.....	86	.....	.....	.....	5360	.....	T
Velvet bean....	S.	Sorghum..	1st	'99	.....	2.2	.....	59	.....	.....	.....	.....	T
Cowpea.....	V.	Corn. ....	2nd	'00	3.6	.....	15	.....	2.0	8	.....	.....	T
Cowpea.....	S.	Corn. ....	2nd	'00	.....	1 6	.....	6	.....	.....	.....	.....	T
Velvet bean....	V.	Corn. ....	2nd	'00	2.6	.....	11	.....	2 4	10	.....	.....	T
Velvet bean....	S.	Corn. ....	2nd	'00	.....	.2	.....	1	.....	.....	.....	.....	T
Velvet bean....	V.	Cotton ..	1st	'99	546	.....	64	.....	.....	.....	.....	.....	T
Cowpea.....	V.	Cotton ..	1st	'99	696	.....	83	.....	.....	.....	.....	.....	T
Velvet bean....	V.	Sorghum..	2nd	'00	3.1	.....	61	.....	.....	.....	.....	.....	T

Velvet bean	V.	Oats.	1st	'98	20.2		240		380	17 6	127	3872	F.
Velvet bean	S.	Oats.	1st	'98		30.3							F.
Cowpea.	V.	Oats.	1st	'98	20 4		242						11. F.
Cowpea.	V.	Oats.	1st	'98		26 0			309	110.1	135	2420	F.
Velvet bean	V.	Corn, late	2nd	'98	2 1		36			0 7	9		F.
Velvet bean	S.	Corn, late	2nd	'98		1 9			33				F.
Cowpea.	V.	Corn, late	2nd	'98	0 9		16						F.
Cowpea.	V.	Corn, late	2nd	'98		0.4			7	11.0	16		F.
Velvet bean	V.	Wheat.	1st	'00	5.4		174						F.
Velvet bean	S.	Wheat.	1st	'00		4.7			151				F.
Cowpea.	V.	Wheat.	1st	'00	5.9		190						F.
Cowpea.	V.	Wheat.	1st	'00		8.7			280	12 8	131	2004	7 9 F.
Sp. Peanuts	††	Rye.	1st	'00	4280		181						F.
do. nuts rem'd		Rye.	1st	'00	1080		41						F.
Run'g Peanuts.	All.	Rye.	1st	'00	2852		121						F.
Cowpea.	V.	Rye.	1st	'00	2600		110						F.
Velvet bean	V.	Rye.	1st	'00	2360		100						F.
Velvet bean	All.	Rye.	1st	'00	3360		142						F.
Sp. Peanuts	V.	Sorghum.	2nd	'01	Loss.		Loss.						F.
Run'g Peanuts.	All.	Sorghum.	2nd	'01	960		16						F.
Cowpeas.	V.	Sorghum.	2nd	'01	400		7						F.
Vel. beans (av.)	V.	Sorghum.	2nd	'01	1995		37						F.

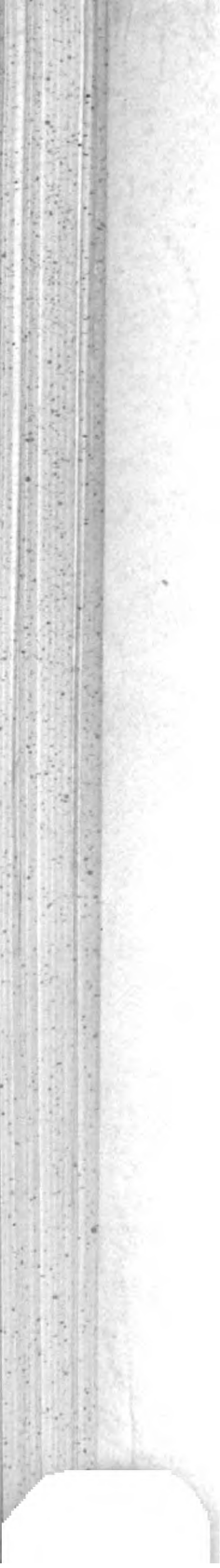
\* Nitrate of soda used both on non-legume and legume plot.

\*\* Reducing the increase to that on corresponding cowpea plot.

† Stubble afforded the larger yield.

†† Peanuts eaten by hogs on land where grown.

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**HERD RECORD AND CREAMERY NOTES**

BY R. W. CLARK.

**Cultural Experiment Station**

OF THE

**Agricultural and Mechanical College,**

**AUBURN.**

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**R. W. CLARK.**

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## **HERD RECORD AND CREAMERY NOTES**

BY R. W. CLARK.

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ying be made profitable in Alabama is a  
en asked.

d winters, long pasture seasons, and a great  
oiling crops, along with the output of the oil  
ills, afford a large field from which to select

The State is badly in need of such profits  
om dairying and live stock growing in gen-  
appearance of our rural communities. the  
d condition of our soils, the tremendous  
the commercial fertilizer trade, and the vast  
money (the proceeds of our only money crop,  
t every year for hays, grains, meat and dairy  
e convincing arguments against the exclu-  
g of corn and cotton and a strong one in  
ersified farming.

builds up the soil. From 75 to 90 per cent.  
izing constituents of the food consumed is  
the manure. Dairying makes the farmer  
t by giving him, daily, a salable product.  
med one day is turned into cash the next,  
f the risk incident to making a crop of corn  
s avoided. No line of farming in the South  
n of returns as dairying when intelligently  
The long growing season makes the dairyman  
endent of drought, a great menace at times  
ctions, especially where the summers are  
e climate is most salubrious. Many of the  
ses common in other sections, caused by close

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housing are almost unknown. Cattle can be turned every day so far as temperature is concerned, but they should be housed at night during the winter.

The demand in the South for good dairy products is always strong and especially so at the present time. It is likely to continue so for many years. Cheese sells for 12 to 20 cents per pound, butter 20 to 35 cents per pound, and whole milk for 20 to 40 cents per gallon at retail.

In calculating the cost of food for each animal in the station herd the value of home-grown stuff was estimated. Bought stuff is figured at its market price.

	Price per ton for the year 1900-01.	Price per for the 1901-
Hay .....	\$10 00	\$10 00
Ensilage .....	2 00	
Oat straw .....	5 00	
Cotton seed hulls .....	4 00	
Soyling crops (fed green) .....	2 00	
Wheat bran ....	20 00	
Cotton seed .....	9 00	
Cotton seed meal .....	20 00	
Rice polish .....	.....	
Skim milk .....	25c per cwt.	30c per cwt.

The value placed on oat straw in the above table is too low. Pasturage is estimated at fifty cents per month for cows and grown animals and thirty cents per month for young animals.

following record shows what the station herd did  
years ending September 1, 1902 :

SEPTEMBER 1, 1900, TO SEPTEMBER 1, 1901.

Breed.	Age at beginning of milking year.		Average weight— Pounds.	Milk— Pounds.	Butter— Pounds.	Cost of keep, in- cluding pasture.	Cost of butter per pound.		Cost of milk per gallon.	Profit on butter at 25c. per pound.
	Yr	Mo					Cents	Cents		
Jersey..	7		828	3,492.8	168.4	\$24.29	14.4	5.7	\$17.85	
Jersey..	10	2	804	3,740.4	205.4	21.09	10.2	4.6	30.39	
Jersey..	6		810	4,665.7	232.7	24.90	10.7	4.4	33.27	
Jersey..	2		649	3,095.6	216.5	20.69	9.5	5.3	33.55	
Jersey..	2	6	614	5,065.8	331.7	24.28	7.3	3.8	58.71	
Holstein	9	4	1003	4,676.3	215.3	28.15	13.0	4.9	25.83	
Jersey..	5	1	767	4,218.6	246.0	23.56	9.5	4.6	38.13	
.....	.....		782	4,136.4	230.8	\$23.85	10.6	4.7	.....	

per cent. of fat, 4.7.

SEPTEMBER 1, 1901, TO SEPTEMBER 1, 1902.

Jersey..	7	10	805	4,581.3	234.7	\$30.97	13.2	5.5	\$27.69	
Jersey..	11		880	4,806.6	264.8	30.21	11.4	5.1	35.99	
Jersey..	7	1	847	3,519.9	193.5	22.74	11.7	5.3	25.73	
Jersey..	3		786	2,271.2	159.1	15.43	9.6	5.5	24.50	
Jersey..	3	8	676	4,316.0	297.9	26.31	8.8	4.9	48.25	
Jersey..	6		814	4,290.9	225.0	24.93	11.0	4.7	31.50	
Jersey..	2		662	3,321.5	217.7	22.49	10.3	5.5	32.00	
Jersey..	3	2	692	4,586.5	286.0	24.75	8.6	4.9	47.01	
Red Poll	2	11	1131	2,262.2	113.1	20.90	18.4	7.5	7.46	
.....	.....		810.3	3,772.9	221.3	\$24.30	11.4	5.4	.....	

per cent. of fat, 5.00.

water profit for the year 1900 and 1901 is due  
prices of foodstuffs, more copious feeding of  
during the winter and a better summer pasture.  
amount of grain in the ration usually depended  
character of the grain, the character of the  
the condition of the animals. All things be-  
ne, a well developed cow several months along  
n received less grain per 1000 pounds live

weight than a cow not so well developed and not so along in lactation. With cow pea hay and ensilage the grain part of the ration rarely exceeded 6 and 7 lbs. per day, and often dropped to 2 and 3 lbs. per day. Indiscriminate feeding of grain and poor cows are usually the cause of losses and of small profits to the dairymen. Liberal, judicious feeding and kind treatment go hand in hand.

Ada, although possessing good dairy type, carries considerable flesh, and during the year 1900 and 1901 gave a small profit, it being an off year with her. Clementina is the poorest cow. She is of the beef type and is well covered with heavy flesh. The feed cost of Houron for the year 1901 and 1902 is light. She milked heavily when fresh, but began to dry off early and then cow pea hay was partially substituted for grain. Her cost of keep (\$15.43) for the year 1901 and 1902 is low because she calved in the summer, did her best on grass and was far along in lactation by winter. They allowed light feeding of grain during the winter (2 lbs. per day), cow pea hay, sorghum hay and oat straw forming the greater part of her ration. The advisability of so light a grain ration is questioned. A long pasture season means cheap production.

Young cattle are usually turned to pasture the latter part of March and are not taken up until about the middle of December. Cows are turned to pasture in the middle of April, and then receive grain only while milking. They are soiled in late fall but depend more or less on pasture until the first of December.

On the whole the yearly productions are smaller than they ought to be. A cow should give from 5000 to 7000 lbs. of milk per year and make not less than 300 lbs. of butter.

## COST OF RAISING HEIFER CALVES.

Hazena, a registered Jersey was dropped October 22, 1899, and weighed 56 lbs. The first year she consumed 59 lbs. whole milk, 2738 lbs. of skim milk, 66 lbs. bran, 24 lbs. of hay and was on pasture 161 days. When one year old she had cost \$12.86 and weighed 435 pounds. The second year she received sorghum hay, ensilage, oat straw, cornstover and a little cotton seed and bran, and was on pasture 224 days. The cost of keep the second year was \$9.09 and she weighed 665 lbs. She dropped her first calf when lacking seven days of being two years old. Total cost of keep up to the time of calving was \$21.95.

Ella, a registered Jersey, was dropped August 12, 1900, and weighed 50 lbs. The first year she consumed 59.5 pounds of whole milk, 1195 pounds skim milk, 80 pounds bran, 63 pounds of corn meal, 405 pounds hay and was on pasture 112 days. She cost, including pasture, during her first year, \$11.65, and weighed when 2 months old 340 pounds.

The second year, aside from pasture, she received cotton seed, cornstover, oat straw and ensilage. She dropped her first calf when 22 months old. The cost of keep the second year up to time of calving was \$7.61, making a total cost of \$19.26.

Peggy, another Jersey, was dropped July 23, 1900, and weighed 36 pounds. The first year she consumed 87.5 pounds whole milk, 1097 pounds skim milk, 191.6 pounds bran, 67.8 pounds corn meal, 399 pounds hay and was on pasture 91 days. She cost \$11.49 and weighed 350 pounds when one year old. The second year she received the same kind of feed as Ella. She dropped her first calf when just two year old. The cost

of keep the second year was \$7.99, and the total cost of keep was \$19.48.

Jenny, a registered Jersey, was dropped November 24, 1900, and weighed 38 pounds. The first year she consumed 52 pounds whole milk, 1740 pounds skim milk, 45.5 pounds bran, 176 pounds hay and was on pasture 217 days. She cost \$9.60 and weighed 295 pounds at one year old.

The second year she received the same kind of food as Ella and Peggy. By reason of an accidental service she dropped her first calf June 24, 1902, at nineteen months of age, and then weighed 445 pounds. The cost of keep for the second year was \$7.61, and the total cost of keep for nineteen months was \$17.21.

Alamarzena, another registered Jersey, was dropped April 16, 1901, and weighed 50 pounds. She received the same kind of food as the others mentioned above. When one year old she weighed 350 pounds and cost \$13.66.

Mabel, Hazena's first calf, was dropped October 15, 1901, and weighed 43 pounds. She consumed 92 pounds whole milk, 1191.2 pounds skim milk, 322.7 pounds hay, 204.2 pounds bran, and was on pasture 165 days. The total cost of keep at one year old was \$11.40.

*Summary of Cost of Raising Heifer Calves.*

NAME.	Cos of keep the first year.	Cost keep one second year.	Total cost of keep to time of calving.
Hazena .....	\$12 86	\$9 09	\$21 95
Jenny .....	9 60	7 61	17 21
Peggy .....	11 49	7 99	19 48
Ella .....	11 65	7 61	19 26
Alamarzena .....	13 66	.....	.....
Mable .....	11 40	.....	.....
Average .....	\$11 77	\$8 07	\$19 47

...e, Peggy and Jenny are undersize and would not  
 been bred so early as they were had not a neigh-  
 bull, in an enjoining pasture, broken into the Sta-  
 erd. They are very small, due mainly to early  
 ng and to a small consumption of skim milk when  
 young calves.

...re can be no set age at which young dairy heifers  
 l be bred. If they are well developed, strong and  
 y they should drop their first calf when 24 to 30  
 as old.

...fers should be kept growing from the time they  
 rn until they reach maturity. A shortage of a few  
 s worth of feed on the calf will mean a loss of  
 dollars at the pail when the calf becomes a cow.  
 terial advancement is to be made in animal breed-  
 e pregnant mother must be well fed. The foetus  
 l be well nourished from the time the dam con-  
 until it is dropped and has reached the goal to  
 it is destined.

#### REMOVING BITTER WEED TASTE FROM CREAM.

...ing the last three years considerable effort has  
 made to find a means by which the odor and taste  
 d onion and bitter weed may be removed from milk  
 cream. In the spring of 1901 the writer was re-  
 ed to try a patent compound claimed to remove all  
 of weedy taste from milk. It was fed to the Sta-  
 erd according to the directions of the manufacturer  
 ur weeks, in which time it proved to be an absolute  
 e. Cooking soda (saleratus) was also given a like  
 but failed of the purpose claimed for it by some  
 e. Having failed so far to find anything that when



fed to the cows would remove weedy taste in the milk. The next step was treating the milk and cream.

The following are creamery notes taken in the carrying out of this work :

<i>Treatment of cream before running through the separator.</i>	<i>Notes on treated cream coming from the separator; untreated cream being very</i>
One gallon of cream was thoroughly mixed with 2 gallons of water, at a temperature of 150° F., in which one ounce of saltpeter had been thoroughly dissolved.	Bitterness removed, but flavor of cream not good, rather soapy.
Same as above, but no saltpeter used.	Not a trace of bitterness in washed cream.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Not a trace of bitterness in cream, and of a fine flavor.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F., and containing 1 oz. of saltpeter.	Bitterness removed, but cream not very good.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 160° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Bitterness removed.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 74° F.	Excellent cream, not a trace of bitterness.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 68° F.	A slight trace of bitterness in the cream, but this would not nearly be detected.
One gallon of cream was thoroughly mixed with 2 gallons of water at a temperature of 69° F.	Slight trace of bitterness in cream.

ed taste was removed entirely from cream by mixing it with two or more parts of water at a temperature above 70 deg. Fahrenheit, and then passing the whole through the separator.

Acid dissolved in water was tried as an aid in removing the bitterness, but as good results were not obtained without it as with it.

And slowly heating milk and cream to various temperatures did not remove bitterness but often gave a cooked taste.

Acid made from washed cream (as above) was proof of all bitterness by the Station customers. Acid made from unwashed cream was decidedly bad and was often rejected by the customers. No means were found to remove the bitter weed taste from whole milk. The cream of 1902 milk and cream were treated for the same reason as in the previous year to remove the bitter weed taste.

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The following are the creamery notes taken in the course of this work :

<i>Treatment of cream before running it through the separator.</i>	<i>Notes on the treated cream after coming from the separator.</i>
One gallon of cream was thoroughly mixed with three gallons of water at a temperature of 90° F.	Flavor not removed; cream bad.
One gallon of cream was mixed with two gallons of water, at a temperature of 90° F., in which was dissolved one ounce of saltpeter.	Flavor bad, and made worse by the use of saltpeter.
Same as preceding treatment.	Flavor still bad.
Same as preceding treatment, except temperature of water 100° F.	Flavor still bad.
Same as preceding treatment.	Flavor bad.
One gallon of cream was mixed with two gallons of water at a temperature of 212° F., in which was dissolved one ounce of saltpeter.	Flavor still bad.
Same as preceding treatment.	Flavor very bad, and from this cream was rejected to the station customers.
Same as preceding treatment.	Same result as above.
One gallon of cream was mixed with two gallons of water, at a temperature of 95° F.	Cream bad.

and taste of wild onion was not removed from cream by any method of treatment employed. It was washed as above with and without salt at different temperatures, but the onion taste was not removed. Butter made from the cream was rejected by the Station customers. The slow heating of milk and cream to various temperatures did not remove the objectionable imparted by the onion.

It was thoroughly mixed with ether and carbon tetrachloride and these were then evaporated. The onion taste was partly removed in both cases, but the cream was not strong enough of the ether and carbon bisulphide to be fit for use.

The compound in the bitter weed which gives milk a bitter taste is held very largely, if not entirely, in the serum. The more completely the serum is separated from the fat the less is the degree of bitterness in the cream.

The compound in the wild onion which gives it a bad flavor is held very largely, if not entirely, in the fat, and the more completely the serum is separated from the fat the more concentrated is the flavor in the cream.

Too much cream makes it thick and necessitates adding too much skim milk, which may be a starter, to bring it to proper consistency before churning. If a large amount of starter is used to thin with, a shorter length of time is required for ripening, therefore the cream should be watched closely until the proper degree of ripeness is reached.

When starter as used above means sour milk that is used to sour the cream.

Containing bad flavors but not sour enough to be rejected, can often be improved by washing. The cream the less likely is it to sour and clabber.

## DIFFERENT SYSTEMS OF CREAMING.

The question is often asked, does it pay to run a cream separator for a small amount of milk.

The following table gives the average per cent. of cream left in the skim milk by the different systems of creaming, but at different temperatures. As the use of cream separator on the average farm in Alabama, is generally out of the question, it was not used, but conditions were taken into consideration they exist on the average farm, and the results secured are believed to be fairly representative of practical conditions. This work was done in August when the weather was hot, except that one of the deep setting tests was made in April.

## SEPARATOR VERSUS DEEP SETTING VERSUS SHALLOW PANS

System.	Temperature, Degrees F.	Per cent. of fat in skim milk	
		Average.	Min.
Separator .....	81.0	.03	.01
Deep setting .....	50.0	.54	.30
Deep setting .....	83.6	1.30	.80
Shallow pans .....	85.7	.60	.35

There is a heavy loss in creaming milk by the gravity system. During hot weather the loss may be one-fourth to one-third of the total butter fat. Shallow pans give better results than deep cans. With the separator the loss of fat in the skim milk was very slight, hardly worth considering. Where facilities for handling cream and butter can be had, and where the skim milk is practically wasted, it will pay, according to the data in the above table, to have a separator for even as small a number as two good cows. These two cows together would produce 12,000 pounds of milk per year. One-eighth of the whole milk being cream, there will be 10

of skim milk. As the separator leaves only .03 per cent. of fat in the skim milk, there will be a saving during the year of 3.1 pounds of butter fat, the equivalent of 3.6 pounds of butter. With deep setting at a temperature of 83.6 degrees Fahrenheit (a close approximation to our summer temperature), there will be a loss of 159 pounds of butter in the skim milk, between one-third and one-fourth of the total. With a low pan setting at a temperature of 85.7 degrees Fahrenheit, the loss will be 73.5 pounds of butter in the skim milk. Along with the saving of butter fat a separator gives better cream, a better butter and better skim.

The cream separator is indispensable to the farmer of the Gulf States of the South.

#### EFFECT OF FOOD ON THE MELTING POINT AND VOLATILE ACIDS OF BUTTER.

During the year 1901 feeding experiments were carried on to determine the effect of different amounts of cotton seed, cotton seed meal and cotton seed hulls, in combination with bran and sorghum hay, on the composition of butter. For this purpose six cows were divided into two groups of three each. They were fed in the barn all that they would eat up clean twice a day, and were confined in stalls during the night. One week of preparatory feeding preceded the experiment proper, which lasted four weeks.

**FOOD AND AVERAGE COMPOSITION OF BUTTER FROM E  
KIND OF FOOD.**

Group.	Ration.	Melting point of butter degrees centigrade.	C. C. of alkali required to neutralize the volatile
I	9 pounds cotton seed 3 pounds bran 10 pounds sorgum hay	41.1	
II	5¼ pounds cotton seed meal 3 pounds bran 10 pounds cotton seed hulls	40.7	

There is practically no difference in the melting point and volatile acids of the butter made from the above rations.

Analysis of a sample of Northern butter, made at the same time, in which no cotton seed products were used, gave a melting point of 24.5 degrees (centigrade), required 13.5 c. c. of alkali to neutralize the volatile acids in 2.5 grams of fat.

During April and May nine cows were divided into four lots of two cows each and one lot of one cow. They were fed grain night and morning and confined to the barn only while eating their grain and being milked. Pasture was the only forage received and consequently all received of it alike. The feeding period proper lasted three weeks.

**AVERAGE COMPOSITION OF BUTTER FROM EACH  
KIND OF FOOD.**

<b>Ration.</b>	<b>Melting point of butter degrees centigrade.</b>	<b>C. C. of alkali required to neutralize the volatile acid in 2.5 grams of fat.</b>
3 pounds cotton seed 1 pound bran	41.76	10.6
3 pounds cotton seed meal 1 pound bran	41.92	9.6
5 pounds cotton seed meal 1 pound bran	39.6	10.37
8 pounds cotton seed meal 1 pound bran	40.84	10.1
4 pounds bran	38.6	9.65

cotton seed and cotton seed meal to cows on  
had a slight effect in hardening the butter, in-  
the melting point from 1 to 3 degrees centi-  
three pounds of cotton seed meal and one  
bran gave as hard a butter as eight pounds of  
d meal and one pound of bran.

atile acids in the butter were not materially  
y the different rations.

**MILK PRESERVATIVES.**

y of milk preservatives for composite testing,  
e in order to ascertain the one best suited to  
ions. Potassium bichromate, mercuric chloride  
alin were used. Each cow's milk was sampled  
drawn, and the sample taken was put into a

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glass jar. At the end of the week these composite samples of milk were tested for butter fat and notes taken which are herewith presented.

Potassium bichromate, grains used for one pint of milk.	Mercuric chloride, grains used for one pint of milk.	Formalin.	Season.	Remarks.
3.08	.....	.....	Winter...	Test very good.
3.82	.....	.....	Winter...	Test fairly good.
4.62	.....	.....	Winter...	Test fairly good.
5.35	.....	.....	Winter...	Test fairly good.
.....	3.85	.....	Winter...	Test very poor.
.....	4.62	.....	Winter...	Test not satisf.
.....	6.16	.....	Winter...	Test not satisf.
.....	7.7	.....	Winter...	Test not satisf.
3.08	.....	.....	Summer...	Test not satisf.
3.82	.....	.....	Summer...	Test not satisf.
4.62	.....	.....	Summer...	Test not satisf.
5.35	.....	.....	Summer...	Test not satisf.
.....	3.85	.....	Summer...	Test not satisf.
.....	4.62	.....	Summer...	Test not satisf.
.....	6.16	.....	Summer...	Test not satisf.
.....	7.7	.....	Summer...	Test not satisf.
.....	.....	½% mixture	Summer...	Very satisfactory clear, no sediment below fat line

Three to four grains of potassium bichromate in a pint of milk served fairly well as a preservative, this material being best in the winter but requiring too frequent duplication of test in the summer when the weather is hot. It causes a more or less leathery condition of cream which is difficult to re-emulsify, and in the summer the milk often undergoes a fermentation which causes a loss of butter fat. The milk should not be more than one week old before being tested.

Mercuric chloride proved unsatisfactory in milk.

test with composite samples. The tests were very

one-half per cent. formalin (40 per cent. formaldehyde) proved the most satisfactory of the three preservatives tried and is now being used entirely at the Station. A teaspoonful of formalin to one pint of milk makes a one-half per cent. mixture.

Potassium bichromate, mercuric chloride and formalin are poisonous when taken internally and should be handled with care.

One-half teaspoonful of formalin will keep a pint of milk in good condition for testing for one month in any season.

#### CHURNING EXPERIMENTS.

During the winter of 1900 and 1901 experiments were carried on to ascertain the degree to which cream should be acid before being churned. It has usually been assumed that a fairly high per cent. of acid and a high temperature are necessary in churning the cream of milk from cows receiving cotton seed or cotton seed meal.

*Moderate acidity and high temperature compared with low acidity and low temperature.*

No. of trials.	Pounds of cream churned.	Per cent. fat in cream.	Per cent. acid in cream.	Temperature of churning.	Minutes churning.	Per cent. fat in Buttermilk.	Melting point of butter. Degrees centigrade.
18	33	.37	70	16.7	.56	37.4	
18	33	.25	63	33.4	.19	39.6	

In the 14 trials with an acidity of .37 per cent. and a temperature of 70 degrees Fahrenheit, the minimum and maximum per cent. of fat in the buttermilk was .1 and 2.5 per cent. respectively. In the ten trials with an acidity of .25 per cent. and a temperature of 63 deg. Fahrenheit, the minimum and maximum per cent. of fat in buttermilk was .05 and .5 per cent. respectively. The most exhaustive churning was made in 40 minutes at a temperature of 67 deg. Fahrenheit, with an acidity of .49 per cent. A ten gallon churn was used in this work. The cream was from cows receiving a heavy ration of uncooked cotton seed. The tests were made during the time when cows were on dry food.

In connection with this work notes were taken on the churnability of cream containing high and low percentages of fat. Cream containing 50 per cent. fat or more stuck to the sides of the churn and usually had to be thinned with water before the churning was complete. The best churnings were made with cream containing 33 per cent. fat. Cream containing less than 25 or 20 per cent. fat did not churn well, it being too thin. Cream containing 50 or 60 per cent. fat had better keeping qualities than the cream containing 25 or 30 per cent. fat, because a large per cent. of the bacteria that cause trouble in the latter was eliminated in the skim milk. In ripening thick cream a large quantity of weak starter should be used. This will give good consistency to the cream and consequently a better churn will be secured.

*Churning whole milk with dash and barrel churn*  
As nearly all of the butter made in Alabama is made from whole milk by the use of the dash churn a series of trials of comparing the dash churn with the barrel churn were considered expedient.

## DASH CHURN VS. BARREL CHURN.

## 12-GALLON BARREL CHURN.

Temp. of milk when churned, Degrees Fah.	Minutes churning.	Per cent. of fat in Buttermilk.
66	55	.55
85	23	.42
85	13	1.
70	60	1.
75	16	.5
76.2	33.4	.69

## 3-GALLON DASH CHURN.

75	16	.5
80	15	.5
85	15	1.
85	40	.4
66	10 1	.55
78.2	37.4	.59

ing to the above reported trials, with their  
ations, the dash churn gives practically the  
lts as the barrel churn, and vise versa. In  
reported above the milk, when churned, was in  
ition, and was well clabbered.

he barrel churn the buttermilk can be drawn  
he bottom, and the butter washed better and  
y than with the dash churn. This is the only  
that the author can see of the barrel churn  
dash churn for churning whole milk.

ethod of churning whole milk is practicable  
able in the South during the summer months  
weather is hot and ice can not be had, and  
of the buttermilk is consumed by the family.  
od butter for local and immediate consump-  
e made if the milk is cooled as much as pos-  
a drawn, and sour milk (starter) of good  
ded immediately. When the temperature can  
trolled to any extent the ripening (souring)  
gin at once.

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Modern dairy methods must be adopted by the South if it receives the full benefit of its natural dairy advantages.

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### SUMMARY:

1. The average yearly production per cow in the Station herd, for the two years ending September 1902, was 3954.6 pounds of milk and 223 pounds of butter. The average yearly cost of keep per cow was \$24.00, the average cost of butter per pound was 11 cents, and the average cost of milk per gallon was 5.5 cents.

2. The average cost of raising a heifer calf the first year was \$11.77, the second year \$8.07 and the total cost to time of calving was \$19.47.

3. Bitter weed taste was removed from cream by mixing it with two or more parts of water at any temperature above 70 deg. Fahrenheit and then running through a cream separator. No means were found which bitter weed taste could be removed from milk. The compound in the bitter weed which gives milk a bitter taste is held very largely, if not entirely, in the milk serum. The more completely the serum is separated from the fat the less is the degree of bitterness in the cream.

4. Wild onion flavor was not removed from cream by mixing it with water and then running it through the cream separator. Saltpeter dissolved in the water thus used was of no value. No method was found by which the onion flavor could be removed from either milk or cream. The compound in the wild onion which gives milk a bad flavor is held very largely, if not entirely, in the fat, and the more completely the serum is separated

at the more concentrated is the onion flavor in

average percentages of fat left in the skim separator, deep cans and shallow pans were 1.6 respectively. Shallow pans gave decidedly less than deep cans. The separator is indistinct to the dairymen of the South.

ration consisting of 9 lbs. cotton seed, 3 lbs. bran and 10 lbs. sorghum hay gave a butter practically equal in firmness and volatile acids to a butter made from consisting of 5½ lbs. cotton seed meal, 3 lbs. bran, and 10 lbs. of cotton seed hulls. Feed-seed and cotton seed meal to cows on pasture gave the melting point of the butter 1 to 3 degrees below.

Three pounds of cotton seed meal and one pound of wheat bran gave as hard a butter as eight pounds of cotton seed meal and one pound of bran. The volatile acids in the butter were not materially affected by these different rations.

Sodium bichromate, mercuric chloride and potassium bichromate were tried as preservatives for composite butter.

One-half per cent. mixture of formalin (40 per cent. formaldehyde) gave the best results. One-half per cent. of formalin will keep a pint of milk in good condition for testing for one month.

Churning cream from cows receiving cotton seed meal .25 of 1 per cent. lactic acid in the cream.

with a temperature of 63 deg. Fahrenheit, required more exhaustive churning than .37 of one per cent. lactic acid with a temperature of 70 degrees Fahrenheit.

In a churning experiment of five trials, the dash churn proved as satisfactory as the barrel churn for churning whole milk.

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ALABAMA.

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## Pasture and Feeding Experiments with Pigs.

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By J. F. DUGGAR.

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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# GRAZING AND FEEDING EXPERIMENTS WITH PIGS.

BY J. F. DUGGAR.

## *Summary.*

Pigs made a more economical growth just after weaning than did sow and pigs just before weaning time.

The following plants were tested as hog food, the hogs doing the harvesting; these plants are available for use in the months indicated:

Spanish peanuts, August to December.

Chufas, November to March.

Cowpeas, July to November.

Sweet potatoes, August to November.

Sorghum, July to November.

Vetch and oats, March, April and May.

Dwarf Essex rape (spring sown), May and June.

Dwarf Essex rape (fall sown), December, January, February, March, and part of April.

In most cases it was necessary to feed, in addition to the above crops, from one-fourth to one-half of the usual ration of grain. If we assume that of this grain 5 pounds was required to produce one pound of increase in live weight, we have left the following amount of growth of shoats attributable to one acre of each crop after deducting the gains due to the grain consumed.

Peanuts (with grain) in 7 tests averaged 333 pounds of growth, now worth \$16.65.

Peanuts alone in 2 tests averaged 281 pounds, worth \$14.05.

Chufas in 2 tests averaged 307 pounds, worth \$15.35.

Cowpeas in 2 tests averaged 229 pounds, worth \$11.45.

Essex rape in 2 tests averaged 452 pounds, worth \$22.50.

Sorghum in 2 tests averaged 174 pounds, worth \$8.70.

One acre of the best of these crops (peanuts, rape, and chufas) afforded pasturage for one month for at least 25 100-pound shoats, when a half ration of grain was fed.

The average amounts of grain required to make one pound of growth on shoats, consuming also the crops below, were as follows:

- 1.77 pounds of grain with peanuts;
- 2.30 pounds of grain with chufas;
- 3.07 pounds of grain with cowpeas;
- 2.68 pounds of grain with rape;
- 3.70 pounds of grain with sorghum;
- 3.13 pounds of grain with sweet potatoes.

Pigs grazing on sorghum, fully headed out, ate only 12 per cent less grain per pound of growth than those supported entirely on corn.

Shoats fed on a mixture of corn meal and of 20 or 25 per cent cotton seed meal in most experiments ate but little food and made very slow growth. In other experiments they required only 3.84 and 4.68 pounds of this mixture per pound of growth.

The feeding of cotton seed meal as part of the grain ration for 34 to 38 days in most cases had a poisonous effect on shoats weighing from 59 to 118 pounds each. No ill effect was noticed prior to the thirty-third day and some pigs showed no perceptible ill effects on the thirty-second day.

on seed meal caused death or sickness of shoats constituting one-fifth or one-fourth of the grain whether the cotton seed meal mixture was fed alone or in connection with a bountiful supply of sorghum or peanuts.

calculated on a basis of 100 pounds live weight, daily of .25, .40, .41 and .53 of a pound of cotton seed meal for 34 to 38 days caused sickness or death; .61 of a pound daily for 35 days fed in different years to shoats of practically the same size caused evident unthriftness in one experiment, while in the other no immediate effects were discernible. Shoats averaging 143 pounds in weight were not hurt by eating for 31 days a pound of cotton seed meal daily per 100 pounds live weight. Evidently the younger the pig the more susceptible they are to cotton seed meal poisoning.

The health of shoats was injuriously affected or death resulted, where, in an exclusive mixed grain ration, the amount of cotton seed meal consumed per 100 pounds live weight reached, with the smallest shoats 9.2 pounds and with larger shoats, 21.4 pounds; while in another experiment 21.5 pounds of cotton seed meal were consumed per hundred weight without immediate effects of injury, and in a fourth experiment 22.6 pounds per 100 pounds of live weight was consumed without visible effects on the health of large shoats. When a cotton seed meal mixture was fed in connection with grazed sorghum, cut sorghum, or grazed peanuts, toxic effects were manifested when respectively 10.9 and 17.7 pounds of cotton seed meal per hundred weight had been consumed. We obtained highly satisfactory growth when some cotton seed meal was fed in short periods to shoats while grazing peanuts. Shoats fed up to the date of slaughter made a very good gain. Chufas softened the lard to an almost equal

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The feeding of grain of any of the kinds tested to pigs whose flesh had previously been softened by feeding on peanuts greatly solidified the lard, but the exclusive feeding of grain for 26 to 35 days just before butchering failed to make the flesh and lard as firm as that of pigs which had never consumed peanuts.

When a mixture was fed containing 20 or 25 per cent of cotton seed meal and the remainder corn meal, the melting point of the lard was 3.4 degrees F. higher than when only corn meal was fed.

Rice bran was not relished by hogs and it did not afford rapid growth.

Rice polish in 5 experiments proved superior to corn meal. One pound of growth required only 3.73 pounds of rice polish as compared with 4.74 pounds of corn meal. Hence 78.6 pounds of polish were equal to 100 pounds of corn meal for shoats.

Corn hearts proved decidedly inferior to corn meal, and to cowpea meal.

Skim milk in moderate amount saved about half of the usual quantity of grain in the ration of shoats.

#### INTRODUCTORY.

Hogs are profitable property. Now that the prices of live hogs and of meat are unusually high this lesson is being brought home most forcefully. Hogs were profitable even when they sold on foot at 3 to 3½ cents a pound as they did locally when our earlier experiments, published in Bulletins Nos. 82 and 93 of this station, were under way.

Whatever the price of hogs or of pork it is necessary to the maximum profit that we make sparing use of corn in most portions of the Gulf States. We need to economize in the use of corn, not by stinting the total

t of food offered, but by making use of other crops can be grown on certain soils at less expense or are more effective foods. To ascertain the relative work-producing values of some of the special hog and their effect on the quality of flesh and lard was the principal aim of most of the experiments in this bulletin.

The experiments herein recorded extend over a period of four years. During the first year of this the details of feeding and weighing were in the charge of Mr. T. U. Culver. During the last three years most of the work has been done by Mr. R. W. Clark, formerly Assistant Agriculturist of this Station. To all of these acknowledgements are due for cordial co-operation and for faithful services.

The results of seven years' experiments in growing hog crops enable us to suggest a succession of crops of proven value to be harvested by hogs, to which we hope to be able to add a number of others when they have been further tested, among them being alfalfa, artichokes, pumpkins and soy beans.

*Succession of hay crops.*

Months used.	Crops.
and January...	Fall-sown rape and chufas.
, to February...	Fall-sown rape, vetch and oats, rye, wheat, etc.
March...	Vetch and oats, crimson clover, oats and wheat
April...	Spring-sown rape, vetch and oats, wheat and the usual pastures.
May...	Spring rape, stubble fields, turf oats and the usual pastures.
June...	Sorghum, early varieties of cowpeas, and the usual pastures.
July and August...	Spanish peanuts, cowpeas, sweet potatoes and sorghum.
September...	Chufas and fall-sown rape.

Among these special hog crops attention is here directed to Dwarf Essex rape, because it is so little known, so palatable, so nutritious and because it can be so effectively used at once to relieve, to some extent, the present scarcity of corn. For the successful growth of rape the land must be as rich and as highly fertilized as for turnips, and preparation, sowing and cultivation are the same as with that crop, except that rape is not thinned. Sow 3 to 5 pounds of seed per acre in narrow drills between September 20 and October 20. Seed are cheap, 10 to 12 cents per pound, and they are sold by all seedsmen. We have also sown rape in March, getting hog pasturage in May and June.

In the summary the present local price of hogs, 5 cents per pound, has been used in estimating the value of one acre of each crop when converted into pork. However, in the body of the bulletin use has been made of the local price prevailing at the time when each experiment was made.

We can estimate the increase in live weight due to one acre of some special crop only by calculating the probable approximate amount of growth due to the grain fed. The amount of grain required, when fed alone, to produce one pound of growth varies of course with many conditions, but the average of many experiments is not very far from five pounds.

In assuming this figure we have sacrificed strict accuracy to uniformity and clear presentation. Those who prefer to use a different factor will find it possible from the data in the body of this bulletin to calculate the net gains per acre of hog crop, whatever factor they select.

## GROWTH OF PIGS BEFORE AND AFTER WEANING.

On farms where dairying is an important industry and where there is an abundance of skim milk for sow and her litter, it is not unusual for the brood sow to nurse a litter of pigs without herself losing weight. In the absence of skim milk we find that the sow generally loses in weight, however bountiful the supply of grain and green material.

For example in the period between farrowing, February 24, 1899, and the beginning of the experiment April 1, a sow lost 29.6 pounds, and her litter of 7 pigs gained 67.3 pounds. During this time sow and pigs were kept in a bare lot and fed a mixture of equal weights of ground cowpeas and a very coarse grade of rice meal, which in this case consisted largely of ground rice chaff. The amount of this mixture consumed in this time was 273 pounds.

This sow and her seven pigs were confined by means of hurdles or movable panels on a field where vetch and turf oats grew together. At the end of a five weeks' period, May 6, the sow was removed and the pigs, now five weeks old, were continued on the same character of pasture three weeks longer, or until May 27. The herbage was more tender and succulent in the earlier periods, though its weight per acre was greater in the later period. The grain fed to the sow and pigs while they grazed on vetch pasture was corn meal.



*Gains made and food consumed before and after weaning.*

	Before weaning.		After weaning.	
	5 weeks.	Per week.	3 weeks.	Per week.
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
Growth made by 7 pigs.....	113.60	22.70	55.40	18.47
Loss in weight of sow.....	19.40	3.88	.....	.....
Net gain in weight of sow & pigs.	94.20	18.82	.....	.....
Meal consumed by sow* & pigs ..	554.20	110.8	244.00*	81.33
Lbs. meal per lb. growth of pigs..	4.88	.....	4.40	.....
Lbs. meal per lb. <i>net</i> gain of sow and pigs. ....	5.88	.....	.....	.....
Area of pasture grazed; square ft.	(8550)	(1710)	(3858.)	(1286.)
Total weight of sow and pigs at beginning of period.....	350.30	.....	.....	.....
Total weight of 7 pigs at the beginning of each period.....	118.60	.....	322	.....

\*Only pigs during last 3 weeks.

A pound of growth was made with less meal, pounds after weaning; before weaning it required 4.88 pounds of corn meal for each pound of growth, but after weaning we deduct from the gains made by the pigs the decrease in the weight of the sow, we find that it required 5.88 pounds of meal to make one pound of growth of sow and pigs. This is a very unsatisfactory rate of growth and probably due, at least in part, to insufficient shade.

*Growth of vetch and oats after grazing*—As stated above, the pigs just after weaning were penned on a mixture of hairy vetch and turf oats, sown the previous October on poor upland soil. Both oats and vetch had been delayed in growth and otherwise injured by the unprecedented cold of February, 1899. Moreover, the vetch had been injured by root-knot.

While penned on the vetch and oats the weaned

as stated in a preceding table 4.4 pounds of  
 al to make one pound of growth, in addition  
 astorage.

interesting to note that on the areas grazed over  
 April 21 the vetch made, after the pigs were  
 sufficient second growth to afford about two-  
 a normal crop of excellent hay, the average  
 second-growth hay on the plots grazed between  
 tes being 1,278 pounds per acre. The vetch  
 e credited with part of the growth made by the  
 h the hay produced as a second growth, and  
 improvement of the fertility of the land which  
 y marked as measured by the growth of silage  
 nted in June of the same year.

#### DWARF ESSEX RAPE AS FOOD FOR SHOATS.

May 27 to June 23 ,1899, these same seven  
 ere maintained on drilled green rape and corn  
 During the first two weeks the rape was pulled  
 ied to the shoats, while during the latter period  
 was grazed. The four weeks of rape feeding  
 reated as one period.

even shoats averaged in weight at the begin-  
 this period 41 pounds each. The area of drilled  
 d was 4190 square feet; corn meal was fed each  
 raging 1.62 pounds per pig per day, or 317.6  
 for the seven pigs in twenty-eight days. The  
 in weight was 103 pounds. Hence to make  
 nd of growth required 3.1 pounds of corn meal  
 6 square feet of rape pasture. This is at the  
 .078 pounds of growth for one acre of rape and  
 unds of corn meal.

assume that for shoats of this size fed on corn  
 ne 5 pounds of this grain would have been re-

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quired for each pound of growth, the acre of rape would be credited with producing alone 413 pounds of growth, worth, at 4 cents per pound, \$16.52.

In addition, the rape which had been grazed made a second growth which was ready for pasturing within a month after the removal of the shoats, but which was ruined by the Harlequin cabbage bugs, or "calico backs," before it could be utilized.

The soil in which this patch of rape grew would be classed as sandy bottom land of medium grade.

Let us turn aside here from the history of this litter of pigs, which we may call litter M, to describe some tests of rape made in 1900 and 1901.

#### RAPE AS WINTER PASTURAGE FOR PIGS.

Dwarf Essex Rape sown in drills on sandy upland on October 13, 1900, was ready for pasturage January 1, 1901, when four pigs from litter O, weaned three weeks before, were confined on it with hurdles which were moved about once a week. The first growth of rape afforded pasturage until March 28. The second growth on land previously grazed over, afforded pasturage from March 28 to April 18.

Throughout the whole period that the pigs were on rape they received also about a half ration of corn meal.

Less rapid and more expensive gains were made in March, when the plants had become tough and ready to seed, than during January and February. The most rapid and economical growth was made during the brief period while the succulent second growth was being consumed.

Weight of 4 pigs January 6 .....	130 lbs.
Weight of 4 pigs March 28 .....	311 lbs.
Gain in 81 days .....	181 lbs.
Corn meal consumed in 81 days .....	524 lbs.
Pounds meal per pound growth .....	2.9 lbs.
Area of 1st growth rape grazed.....	13,912 sq. ft.

This is at the rate of 570 pounds of growth in live weight afforded by one acre of first-growth rape assisted by 1641 pounds of corn meal. If we assume that 570 pounds of corn meal made one pound of growth we have left 242 pounds of live weight, worth \$9.68, to be attributed to one acre of first-growth rape.

March 28, the rape having begun to blossom and having become relatively unpalatable, the hurdles were placed about the rape grazed in January and part of February, on which the second growth was by this time in good condition for pasturage, though small.

On this second growth the pigs remained three weeks, meantime consuming the crop on one-sixth acre and eating 168 pounds of corn meal.

The growth made during these three weeks was 82 pounds, or one pound of growth for only 2.05 pounds of corn meal, which figure indicates that the pigs must have derived about half their sustenance from the green crop. One acre of second growth rape assisted by 1008 pounds of corn meal resulted in a growth of 492 pounds. If we again assume a normal requirement of five pounds of grain for one pound of growth we have 290 pounds of increase in live weight, worth \$11.60, as the value of an acre of second crop rape when converted into pork.

It is fair to add together the gains made on an acre of first growth and of second growth, since part of the area was grazed twice. This gives a growth of 572 pounds of pork then worth \$20.48, as attributable

to an acre of rape grazed twice. This is on the assumption that it would require 5 pounds of an exclusive grain ration to produce a pound of growth.

#### GRAZING SORGHUM, FIRST EXPERIMENT.

Let us now return to the history of litter M, which had grazed on rape until June 23, 1899.

This litter of seven shoats was grazed on sorghum from June 24 to September 2, 1899, meantime receiving daily a very small amount, about  $1\frac{1}{2}$  pounds per day per shoat of a mixture of equal weights of cowpea meal and corn meal.

During this time the seven shoats made an aggregate gain of 22.44 pounds and utilized 15,374 square feet of drilled and cultivated sorghum, and also grazed the second growth on 8380 square feet, or about half of this same plot. The grain meantime consumed was 812 pounds by the lot of seven shoats, or 3.6 pounds grain for each pound of increase in live weight.

This is equal to a gain of 635 pounds of live weight per acre of sorghum, assisted by 2298 pounds of grain. Assuming that if the grain had been fed alone 5 pounds would have been required to produce one pound of growth, we have left 195 pounds of growth attributable to one acre of first growth sorghum and to about half of the second growth on the same.

At 4 cents per pound 195 pounds of growth gives a return of \$7.80 per acre of sorghum.

Doubtless the value of an acre of sorghum would have been considerably greater if the second growth on the entire area, instead of on half of it, had been utilized. It was noticed that the shoats required per week about twice as large an area of second growth as of first growth sorghum.

During a small portion of the time covered by this experiment sorghum was cut and carried to the pigs and when this was done a given area lasted much longer than when hogs were turned in to graze, in which case there was a waste of green food, bitten down and not consumed, and the loss was excessive.

Where labor is abundant and cheap or where the use of a corn harvester is possible it is believed that it will be better to cut and carry the sorghum to the pigs rather than to graze it.

When shoats averaging about 80 pounds received only one and one-half pounds of grain a day per head and were required to make growth chiefly on sorghum, the rate of gain was slow, being a little more than half a pound per day.

The sorghum when grazed was at the stages of growth between early bloom and complete maturity and most of the time it was about five feet high. The yield was rather light, the land being poor, sandy upland, moderately fertilized. The sorghum used in all our grazing experiments has been drilled and cultivated.

#### THE VALUE OF SPANISH PEANUTS AS PASTURAGE FOR PIGS.

In Bulletin No. 93 of this Station the writer has recorded the very satisfactory results of several experiments in grazing pigs on peanuts in 1897. The results now confirm the conclusions which we have heretofore expressed as to the great value of peanuts as food for pigs.

*Peanuts and corn meal.*—A litter of pigs farrowed September 1, 1899, was penned on Spanish peanuts November 4, after weaning. There was only about two-thirds of a stand of peanuts.

The total increase of live weight up to December 2 was 298 pounds, during which time 482 pounds of corn meal was consumed or 1.62 pounds of grain per pound of growth. The area grazed over was 34,944 square feet, or nearly five-sixths of an acre.

This is equal to a gain of 371.4 pounds of live weight from one acre of peanuts assisted by 601 pounds of corn meal. If we assume that it required 5 pounds of grain to produce one pound of growth and subtract that amount of pork we have left 251 pounds of increase in live weight attributable exclusively to a poor crop of peanuts on one acre. With pork worth 4 cents per pound gross this gives a value of \$10.04 to an acre of peanuts converted into pork.

*Peanuts, corn meal and milk.*—From September 3 to November 4, 1899, account was kept of the food consumed by a sow and litter of 9 pigs farrowed September 2. The food consumed during these five weeks was as follows:

355 pounds corn meal at 1 cent.....	\$3.55
921 pounds skim milk at $\frac{1}{4}$ cent .....	2.30
Total .....	\$5.85

In addition to the above food, Spanish peanuts from one-fourth acre of land were also fed.

During this time the sow made a gain of 9 pounds showing that on a sufficiently nutritious and palatable diet the weight of the nursing sow can be maintained. The pigs made a gain of 226.5 pounds. The total gain of sow and pigs was 235.5 pounds, making the cost of grain and skim milk for one pound of growth 2.5 cents.

Assuming that one pound of growth of sow and pigs requires 5 pounds of grain in a ration like this, and

as in certain Wisconsin experiments,  $3\frac{1}{4}$  pounds of milk are equal to one pound of corn, we find per acre of peanuts, assisted by 2552 pounds of corn or its equivalent there was made an increase of 510 pounds in live weight. Deducting the amount attributable to the grain, 510 pounds, we have a balance of 2 pounds of pork as the equivalent of one acre of peanuts, then worth, at 4 cents per pound, \$17.28.

*peanuts and corn meal for shoats in 1902.*—Another lot of 7 shoats was penned on Spanish peanuts from September 11, 1902 to November 2, 1902. Their average weight at the beginning was nearly 100 pounds each. They made a growth of 224.5 pounds while consuming 132 pounds of corn meal and the peanuts on .47 of an acre. To produce a pound of growth required only 1.47 pounds of corn meal. This gain is at the rate of 2.94 pounds of live pork per acre of peanuts assisted by 132 pounds of corn meal. Assuming that five pounds of grain would make one pound of growth we have left 360.5 pounds of growth which we may attribute to one acre of peanuts alone. These shoats were sold after further experimental feeding and brought eight five cents on foot, making the acre of peanuts worth \$18.02.

*Gains made by very small pigs on peanuts alone.*

Litter of seven Poland China pigs was weaned September 4, 1901, and immediately hurdled on Spanish peanuts.

After a week allowed for them to become accustomed to their new food, the experiment proper began, and continued for six weeks, during which time no grain was fed. The initial weight averaged 28.1 pounds. The

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gains in six weeks aggregated 156.5 pounds, which at the rate of a little more than half a pound per day per pig. The area grazed was 13,887 square feet. This is equivalent to a gain of 503 pounds of live pork per acre of peanuts, worth, with pork at 4 cents, \$20.12.

When taken from peanuts October 31, 1901, one of these pigs, No. 12, was butchered and the melting point of the lard determined.

*Peanuts and corn meal in 1899.*—On September 1, 1899, a lot of seven shoats previously supported on sorghum and on a diet of corn and cowpeas (see p. 14) was transferred from sorghum to Spanish peanuts, and to make a properly balanced ration the grain was changed to corn meal.

During the next four weeks the lot of seven pigs made gains of 120.7 pounds while consuming 333 pounds of corn meal and the peanuts on 10,593 square feet. This is at the rate of 496 pounds of growth produced by an acre of peanuts assisted by 1356 pounds of corn meal. If 5 pounds of grain alone would have produced one pound of growth there remains 225 pounds of pork, worth \$9.00, as the value of an acre of peanuts converted into pork. Besides the peanuts there was required 2.73 pounds of corn meal to produce a pound of growth.

A week after the close of this period these seven pigs, all of one litter, were divided into several lots, one lot continuing to graze on peanuts, a second lot grazing on chufas with grain as stated further on, a third lot being penned and fed on a mixture of cotton seed meal and corn meal, and the remaining pig together with one from a different litter being fed in a pen on corn meal alone.

*Peanuts and corn meal in 1899, second period.*—For five weeks certain of these pigs were hurdled on a field of Spanish peanuts. During the last three weeks of this grazing period they gained in weight at the rate of 293 pounds per acre of peanuts, assisted by 274 pounds of corn meal, or one pound of growth for .94 of a pound of corn meal. Crediting the corn meal as before we have left 247 pounds of pork, then worth \$9.88, as apparently attributable to one acre of peanuts.

#### GAINS MADE BY YOUNG PIGS ON CHUFAS.

From November 19 to December 17, 1898, nine Berkshire pigs were hurdled on a field of chufas where there was only a poor stand of plants. They were also fed a little grain, mixed corn and cowpea meal, of which only 262 pounds was fed during the four weeks. The increase in weight was 121.1 pounds and the area grazed over was 7986 square feet. This is at the rate of 660 pounds of live pork per acre of chufas assisted by 1429 pounds of grain or one pound of growth for 2.17 pounds of grain. Attributing one pound of growth to five pounds of grain we have left 374 pounds of increase in live weight as apparently due to one acre of peanuts alone. Hogs were then selling at  $3\frac{1}{2}$  cents per pound on foot, so that the acre of chufas when converted into pork was worth \$13.09.

#### PEANUTS VERSUS CHUFAS VERSUS MIXED GRAIN.

Four lots of pigs (from litters N and P.) were fed for twenty-five days, October 19 to November 13, 1900, as follows:

Lot A.—Spanish peanuts, grazed, and a half ration of mixed grain.

Lot B.—Spanish peanuts grazed, without grain.

Lot C.—Chufas grazed and a half ration of mixed grain.

Lot D.—Mixed grain alone, fed in bare lot, as much grain as shoats would clean up.

The grain fed to Lots A, C, and D., consisted of one third by weight of ground cowpeas and two-thirds ground corn.

The table below gives the data for the last 18 days of the experiment, the preceding week being regarded as preliminary and as needed to fully accustom all lots to their food. At the beginning of the experiment proper lots A, B, C, and D, weighed respectively 363, 256, 318 and 392 pounds.

*Growth made by each lot of 3 pigs and food consumed in 18 days.*

Lot.	Area grazed.	Food.	Grain eaten.	Increase in live weight.	Lbs. gained for 1 lb. growth.
	<i>Square ft.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
A {	8,344	Spanish peanuts, grazed	152 {	81	1.88
B {	12,448	Mixed grain, $\frac{1}{2}$ ration..			
C {	7,937	Spanish peanuts, grazed	152 {	79	1.92
D {	.....	Chufas, grazed .....			
		Mixed grain, $\frac{1}{2}$ ration..	304	70 5	4.31
		Mixed grain, full ration			

Chufas and peanuts in this test were nearly on a equality, and when half a ration of grain was fed with either there was required only 1.92 or 1.88 pounds of grain to produce one pound of growth. As compared with the exclusive grain ration this represents a saving of 56 per cent of the grain by the use of either chufas or peanuts.

Spanish peanuts without grain afforded a very slow growth, and the increase in live weight was only 76

for each acre of peanuts. This is an abnormally low return and due in part to the poor growth and yield of peanuts.

With live pork at 4 cents per pound this gives only 184 pounds of live weight as apparently the returns per acre when no grain was fed, which is entirely unsatisfactory.

A much larger return was made when peanuts were supplemented with a half ration of grain. With lot A, which was due jointly to one acre of peanuts and to 791 pounds of corn was 423 pounds of live pork. Dividing the amount of grain fed to this lot by 4.31, the amount of grain equivalent per pound of growth when nothing but grain was fed, we have 184 pounds of live weight as apparently the return from the grain fed; subtracting this from the total live weight we have left 239 pounds as the return from the peanuts of growth that we may credit to one acre of peanuts.

With pork at 4 cents per pound this gives the value of an acre of peanuts converted into

the value of chufas supplemented by 832 pounds of chufas produced 433.5 pounds of live pork and by the process as above we calculate that one acre of chufas should be credited with  $240\frac{1}{2}$  pounds of pork, or

the present experiment agrees with a previous one, reported in the Alabama Station Bulletin No. 83, p. 118, in showing that it is more profitable to feed some grain to small hogs than to require them to make all their live weight from the nuts.

The following table shows the daily gain per pig, the amount of grain consumed daily per 100 pounds of live weight, the number of days of pasturage afforded by one acre of peanuts or chufas. In calculating the last column the average of the live weight at the beginning and end of the experiment has been used.

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*Peanuts and chufas as pasturage.*

Lot.	Food.	Daily gain per pig	Grain consumed daily per 100 lb. live weight.	Pasturage on 1 acre for a 100 lb. shoat.
		<i>Lbs.</i>		<i>Days.</i>
A	Peanuts, and $\frac{1}{2}$ grain ration..	1.50	2.58	850
B	Peanuts, alone. ....	.41	.....	463
C	Chufas and $\frac{1}{2}$ grain ration....	1.46	2.99	827
D	Full grain ration.....	1.31	4.67	.....

The rate of gain, nearly one and one-half pounds per day per head, was satisfactory except for the lot receiving no grain, with which the daily growth was only .4 of a pound per head.

The second column shows that when shoats were "hogging off" peanuts or chufas they made good use of them. They consumed 2.58 pounds and 2.99 pounds respectively of grain daily for every hundred pounds of live weight.

The third column shows that an acre of peanuts without grain, afforded pasturage at the rate of 463 days for a hundred pound shoat, which is equal to 11.5 months for such shoats for one month. In 1899 when receiving about one-fourth of a normal grain ration pigs grazing on inferior peanuts made moderate gains when the field was stocked at the rate of 13 100-pound shoats for one month. When a half ration of grain was fed the peanuts or chufas lasted nearly twice as long, the rate of pasturing per acre for every 100 pounds of live weight being 850 days for peanuts and 827 days for chufas, equal to the support for one month of 28 100-pound shoats on an acre of peanuts and of 27 on an acre of chufas.

# EFFECTS OF PEANUTS, CHUFAS AND COWPEAS ON FIRM- NESS OF LARD.

At the conclusion of the two experiments just described one barrow from each of the four lots was killed, September 14, 1900, and lard rendered from the fat taken from the jowl of each. The melting points of these samples of lard were determined by Prof. C. L. Hare of Chemical Department.

## *Effect of peanuts and chufas on melting point of lard.*

Food during 26 days before butchering.	Food fed prior to 26 days before butch- ering.	Melting point of fat.		Increased hardness over lot B Deg. F.
		Deg's C.	Deg's F.	
Peanuts, ground	{ Sorghum grazed Ground cowp's & corn	28.0	82.4	10.8
Cowpeas and corn.		22.0	71.6	.....
Peanuts, alone .....	{ Sorghum graz'd: pean'ts Cowpeas grazed.....	27.5	81.5	9.9
Chufas and ground		30.0	87.0	15.6
Cowpeas and corn..	{ Ground cowpeas and corn .....			
Ground cowpeas and corn.....				

The half ration of one-third cowpeas and two-thirds meal fed to lot A, for several months immediately before butchering raised the melting point 10.8 F. The lard of pigs fed partly on peanuts as compared with pigs that had received no grain, but only peanuts for several months. This grain ration fed alone to lot D afforded a lard which was firmer by 15.6 degrees F. than that from pigs which up to the day when they had consumed peanuts.

In this test sorghum shows no marked tendency to firm the lard, at least when its use was discontinued fully a month before the hogs were killed. Additional experiments are required to determine its effect, if any, in this respect when fed up to the last day.

The cowpea evidently afforded a rather firm lard, but our tests do not show exactly how it compared with corn in this respect.

#### GRAZING SORGHUM AND COWPEAS.

September 14th, 1900 twelve pigs recently weaned (litters N and P.) were divided into four lots of three pigs each. The different lots were quite evenly matched in all essential respects and weighed respectively 175.5, 176.5, 170.5 and 193 pounds per lot. The experiment lasted five weeks in addition to the preliminary period.

Lot A was confined by means of movable hurdles on drilled sorghum, in dough and ripening stages, and was supplied with what was regarded as a half ration of a mixture of two-thirds corn meal and one-third cowpea meal by weight.

Lot B was penned on sorghum alongside of lot A; no grain was furnished to this lot, but instead ripe Spanish peanuts were pulled and thrown in the pen daily in quantities estimated as furnishing about a half ration of peanuts.

Lot C was hurdled on drilled Whippoorwill cowpeas on which the pods were ripe, and this lot received no other grain.

Lot D was confined in a small bare pen and furnished with as much as the pigs would consume of the same grain mixture as that supplied to lot A.

*Grain eaten, area of sorghum, cowpeas, and peanuts grazed, and growth made in five weeks by three pigs in each lot.*

Lot.	Food.	Grain eaten.	Increase in live weight.	Lbs. grain for 1 lb. growth.
		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
A	Corn and cowpea mixture...	244	74.5	3.28
	4872 sq. ft. of sorg'm, grazed	.....	.....	.....
B	4872 sq. ft. of sorg'm, grazed	.....	53.5	.....
	29905 sq. ft. of Sp. peanuts.	.....	.....	.....
C	17964 sq. ft. ripe cowpeas...	.....	50.5	.....
D	Corn and cowpea mixture ..	464	124	3.74

tly sorghum was in this case of very slight  
r with lot A sorghum saved only 12 per cent  
rain required by lot D to make a pound of

Equally unsatisfactory was the growth of  
which was made to subsist entirely on sorghum  
nted by peanuts grown without fertilizer be-  
rn rows on very poor sandy land.

grew at the rate of 122.5 pounds of live weight  
of cowpeas, which, at 4 cents per pound, gives  
the value of an acre of a moderate crop of ripe  
when converted into pork.

taste was very great, the peas falling on the  
and sprouting before being consumed. In a  
experiment (Bulletin No. 93) in which some  
furnished to shoats grazing on nearly ripe  
the results were far more satisfactory, one acre  
as assisted by 1578 pounds of corn making 730  
f live pork. If we assume that each five pounds  
formed one pounds of growth, we have 336  
f live pork, worth at 4 cents \$13.44, as the value  
e of cowpeas alone converted into pork in that  
e in this one an acre of cowpeas alone made  
s.

made a very satisfactory growth on the mix-  
ne-third cowpea and two-thirds corn meal, only  
ds of this mixture being required to make one  
growth. The rate of growth was several times  
id than with the pigs dependent entirely upon  
or upon sorghum and peanuts, and considerably  
id than with lot A, which received a limited  
grain and an unlimited supply of sorghum.

verage daily gain per shoat was 1.18 pounds  
ull ration of mixed cowpea and corn meal was  
e average daily consumption of this grain *per*  
*d of live weight* was 5.19 pounds.

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## COTTON SEED MEAL IN THE GRAIN RATION.

November 13, 1900, after the conclusion of the experiment just described, one pig from each of lots C, and D was kept for five weeks on an exclusive grain diet made up of one-fourth by weight of cotton seed meal and three-fourths corn meal. They were given as much as they would eat but did not relish the food.

During the five weeks they gained 67.5 pounds, requiring 4.68 pounds of food per pound of growth. This is an average daily gain of .64 of a pound per head. Near the end of the fifth week the attendant noted the thrifty appearance of the pigs, but no death occurred.

The amount of cotton seed meal which had produced sickness but not immediate death, was 25.5 pounds in the case of a shoat of an average weight of 117.6 pounds. Hence the toxic dose of cotton seed meal was here, per 100 pounds of live weight, 21.4 pounds, or .61 of a pound per pound for 35 days.

After eating this grain, containing 25 per cent cotton seed meal, for five weeks the pigs were slaughtered and a sample of lard from the fat of the body was examined by Prof. C. L. Hare, who found the melting points to be as follows:

*Melting point of lard from cotton seed meal rations*

Lot.	Food during last 5 weeks of life.	Food second month before butchering.	Melting point of lard, Deg.
B	{ $\frac{1}{4}$ cotton seed meal.. $\frac{3}{4}$ corn meal..... do..... do.....	Peanuts, alone .....	87
C		Chufas, &c. { $\frac{1}{2}$ cowpea meal $\frac{1}{4}$ corn meal..	83
D		Full ration { $\frac{1}{2}$ cowpea meal $\frac{1}{4}$ corn meal...	84

lard from some pigs in lot B had melted at 71.6° immediately after the pigs were taken from a peanut ration; now, after five weeks feeding of a ration containing 25 per cent of cotton seed meal, the melting point has risen to 87.4 degrees, a hardening effect of the greases attributable to this food. This cotton seed meal and corn meal mixture did not very greatly influence the hardness of the lard of the lots which had been receiving a partial or exclusive grain ration for a number of weeks before the cotton seed meal feeding was begun.

#### SEED MEAL (25 PER CENT) IN THE RATION OF PIGS.

In the fall of 1899 three Poland China shoats from the same litter, previously maintained on peanuts with a ration of corn meal, and an Essex pig previously maintained on ordinary pasturage and corn, were penned. The Poland Chinas were fed all they would eat of a mixture of one-fourth cotton seed meal and three-fourths corn meal. The third Poland China and the Essex pig were fed in separate pens on corn meal

#### *Comparison of cotton seed meal and corn meal versus corn meal alone.*

Food.	Average weight per pig during experiment.		Growth per pig.		Grain eaten per pig.		Lbs grain per lb. growth.		Daily ration per 100 lbs. live weight.		Daily growth per pig.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
$\frac{1}{4}$ cotton s. meal, $\frac{3}{4}$ corn meal. . .	113 1	14.3		97.7	7 11	2.46		.41				
Corn meal . . . . .	121 5	21		128 8	6.13	3 02		.60				
Corn meal . . . . .	97.5	58 5		200.0	3.43	5.86		1.67				
Corn meal . . . . .	109.5	39 7		164.4	4 13	4.28		1 13				

None of the Poland China pigs (lots 3 and 4) had sufficient grain for rapid growth when changed from peanuts to an exclusive grain diet. As a result of the small daily consumption of food slow growth was made by lots 3 and 4, with the almost inevitable result that the increase in live weight was made at a financial loss. It required 7.11 pounds of the mixture containing cotton seed meal or 6.13 pounds of corn meal alone to make one pound of growth, both figures showing unsatisfactory rates of growth.

The cotton seed meal mixture was decidedly unprofitable, but up to five weeks it was not perceptibly injurious to health. During these 35 days the amount of cotton seed meal consumed per 100 pounds live weight was .61 of a pound daily or a total of 21.5 pounds.

#### EFFECT OF PEANUTS, CHUFAS, CORN MEAL AND COTTON SEED MEAL ON QUALITY OF LARD.

After the conclusion of certain experiments previously described, (grazing peanuts and feeding cotton seed meal in comparison with corn meal) the pigs thus fed were butchered.

Samples of the lard made from the bodies of these pigs and from others which had subsisted for some months on chufas, supplemented by a light ration of grain, were tested by Prof. C. L. Hare of the Chemical Department to learn the temperature necessary to melt the lard.

*Melting point of lard from various foods.*

Pig No.	Food during 5 weeks just before butchering.	Food fed prior to 5 weeks before butchering.	Melting point of fat.	Average melting point of fat
			<i>Degrees F.</i>	<i>Degrees F.</i>
84	Peanuts.....	Peanuts.....	73.5	.....
86	Peanuts.....	Peanuts.....	75.7	.....
Av. 84 & 86	Peanuts.....	Peanuts.....	.....	74.6
87	Chufas.....	Peanuts.....	75.2	.....
89	Chufas.....	Peanuts.....	74.6	.....
Av. 87 & 89	Chufas.....	Peanuts.....	.....	74.9
88	$\frac{3}{4}$ corn meal, $\frac{1}{4}$ cotton seed meal....	Peanuts.....	84.2	.....
90	$\frac{3}{4}$ corn meal, $\frac{1}{4}$ cotton seed meal....	Peanuts.....	84	.....
Av. 88 & 90	$\frac{3}{4}$ corn meal, $\frac{1}{4}$ cotton seed meal....	Peanuts.....	.....	84.
85*	Corn meal.....	Peanuts.....	80.7	80.7
E. Corn meal (Essex)..	Corn and grass pasturage..	.....	86.0	.....

\*This pig was from same litter as Nos. 84, 86, 87, 88, 89 and 90.

It is well known that peanuts produce a soft lard. When the feeding of peanuts was continued uninterruptedly up to the date of slaughter the resulting lard melted at the low temperature of 74.6 degrees Fahrenheit, or at the temperature of an ordinary living room in spring. It has been claimed that by feeding entirely on corn for a few weeks before the date of butchering, the flesh and lard can be brought to the normal degree of hardness. This was not the case in this experiment. By discontinuing the peanuts five weeks before the hogs were killed and feeding thenceforward exclusively on corn meal we succeeded in raising the melting point to 80.7 degrees Fahrenheit, an increase of 6.1 degrees Fahrenheit. This lard, however, was still much softer than that from hogs never fed on peanuts. In a similar experiment in 1897-'98 (see Bulletin No. 93) the feeding of corn during the four weeks imme-

diately preceding the time of butchering effected a considerably greater increase in the melting point of lard from the pigs previously fed on peanuts, but in this test as in the present one, the feeding of corn during a short period did not make the resulting lard equal in firmness to that made by continued feeding of corn.

In this experiment the lard produced by feeding chufa was practically as soft as that obtained from peanut-fed pigs.

After ascertaining in a previous experiment that the melting point of lard from peanut-fed pigs could not be raised to the normal degree of firmness by feeding exclusively on corn during the month immediately preceding death, search was made for some food which might have a greater effect in solidifying the flesh and lard. Cotton seed meal seemed worthy of a trial for this purpose as it has been shown to increase the firmness of butter, and as a few determinations appear to indicate that it produces tallow and suet with a high melting point. Unfortunately no safe method of feeding to hogs for a long period any considerable proportion of cotton seed meal has yet been entirely demonstrated. In small amounts it may be fed for four weeks, or even a little longer without causing death.

In this experiment a mixture of one pound of cotton seed meal to three pounds of corn meal was fed during the five weeks before the date of butchering to pigs which prior to this time had grazed on peanuts. The effects of the food containing cotton seed meal was to raise the melting point of the resulting fat to 84.1 degrees Fahrenheit. This is a gain of 9.5 degrees as compared with an uninterrupted diet of peanuts. The cotton seed meal mixture afforded lard which required for melting a temperature of 3.4 degrees Fahrenheit higher

am that necessary with fat produced by feeding corn meal alone during the same length of time.

The result of this experiment is encouraging as indicating the superior hardening power of a mixture of cotton seed meal and corn meal over corn meal alone. The lard from the pigs fed for six weeks on this mixture was practically as firm as that obtained in this experiment from an Essex pig that had never eaten peanuts, but it was not so firm as the lard produced in the corresponding experiment of 1897-'98 from pigs fed uninterruptedly on corn. (See Alabama Station Bulletin No. 93, p. 30.)

#### COTTON SEED MEAL AS FOOD FOR HOGS IN CONNECTION WITH CORN MEAL AND SORGHUM OR PEANUTS.

On September 14, 1901, a litter of six thoroughbred Poland China pigs, farrowed April 2, was divided into three lots and these were fed as follows:

Lot I, grazed on drilled sorghum, (blooming to ripe stage), and a half ration of grain, as below.

Lot II, in dry lot, fed sorghum from same field, cut to lengths of 1 to 2 inches, and also fed grain like Lot I.

Lot III, grazed on Spanish peanuts and given same grain as other lots.

All three lots received in addition to sorghum or peanuts a mixture of one-fifth cotton seed meal and four-fifths corn meal, which was not greatly relished and of which the pigs in a dry lot could not be induced to eat as much as was desirable. This lot also ate far less sorghum than was desired.

After a week of preliminary feeding the experiment began September 20 and continued until the last week of October.

*Sorghum, grazed and soiled, versus peanuts graze*

Lot.	Pig No.	Weight Sept. 20		Food.	Daily growth per pig.	Total growth.	Grain consumed.
		Each.	Total.				
I	1	61.	135.5	Sorghum grazed; cotton seed meal & corn meal.	.53	36	140
	2	74.5					
II	3	67	124.5	Sorghum in pen; cotton seed meal and corn meal	.11	8.5	94
	4	57.5					
III	5	71	135.5	Peanuts grazed; cotton seed meal & corn meal.	.94	72.5	134
	6	64.5					

During the experiment lot I grazed over (with g waste) 2203 square feet of sorghum and lot 3 consu the peanuts on 3880 square feet; 782 pounds of gr cut sorghum were offered to lot II but only 372 po were consumed. Reducing these results to the b of one acre we have the

*Growth made on one acre of sorghum or peanut*

	Pasture Crops.	Growth per acre of green food.	Grain per acre of green food.	*Gro attri ble acre fo
Lot I.	Sorghum grazed; and grain..	Lbs. 707	Lbs 2768	Lb 1
Lot II.	Sorghum fed; and grain.....	210	2323	10
Lot III.	Peanuts grazed; and grain..	814	1504	5

\* On the assumption that 5 lbs. of grain made 1 pound of growth.

To produce one pound of growth, there was requ 3.8 pounds of grain in connection with sorghum torage, only 1.85 pounds of grain in connection v peanuts and 11.05 pounds of grain when cut sorg was fed in a dry lot.

financial results are quite satisfactory for peane acre of which is estimated as producing 513 of live pork, worth at 4 cents per pound, \$20.52. eef sorghum grazed is estimated as affording 153 of live pork worth \$6.12, while sorghum fed to a pen was consumed in quantities too small to y measureable financial results.

*et of a 20 per cent. cotton seed meal mixture on of pigs.*—A mixture of one-fifth cotton seed meal ur-fifths corn meal was fed as just stated, in ion with sorghum or peanuts continuously from ber 14. All went well until October 24, when 1 in lot II died suddenly. Three days later the ig in lot 1 died and also both pigs in lot II. Oc- 8 the use of cotton seed meal was discontinued t III, which had thus far shown no symptoms or s or unthriftiness, but which, as the subsequent of one of these pigs shows, had been injured by of cotton seed meal. One of these pigs, No. 6, from grazing on peanuts was used in a subsequent ex- nt, in which he died, though not given any more seed meal. The other one was butchered October samples of fat were taken from this one, as well as ne of the pigs that died in each of the other two

us calculate the amounts of cotton seed meal onstituted a dangerous ration when fed for about ks.

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*Amounts of cotton seed meal causing death of shoats  
when fed with corn and sorghum or peanuts.*

	Lot I. Mixed grain and sorghum (grazed.)	Lot II. Mixed grain and sorghum (fed.)	Lot III. Mixed grain and peanuts (grazed.)
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
Total grain per head daily.....	2 06	1 27	1 76
Total grain per 100 lbs. av. live weight	2.67	2 00	2 05
Cotton seed meal per head daily.....	.41	.25	.35
Cotton seed meal daily per 100 lbs. av. live weight.....	.53	.40	.41
Total amount cotton seed meal (incl'g preliminary week) .....	16.60	12 20	15 20
Total amount cotton seed meal per 100 lbs. av. live weight .....	21.60	18.90	17.70

From this table it may be seen that a daily ration containing one-fourth pound or more of cotton seed meal per 100 pounds of average live weight was fatal when continued for about six weeks. No deaths occurred until the small shoats (averaging about 64 pounds) had each consumed 12.2 pounds of cotton seed meal. Per 100 pounds of liveweight the minimum fatal quantity was 18.9 pounds.

EFFECTS OF A 20 PER CENT COTTON SEED MEAL MIXTURE AND  
OF SORGHUM AND PEANUTS ON MELTING POINT  
OF LARD.

Lard was rendered from samples of fat taken from the neck and also from around the kidneys of one pig in each of the lots just referred to. The melting points of the lard were as follows:

*Effect of cotton seed meal on melting point of lard.*

Food.	Lard from kidneys	Lard from jowl
	Deg. F.	Deg. F.
Sorghum grazed; $\frac{1}{2}$ ration of $\left\{ \begin{array}{l} \frac{1}{2} \text{ cotton seed meal..} \\ \frac{1}{2} \text{ corn meal.....} \end{array} \right.$	115.2	87 4
Sorghum fed, do	115 3	85.3
Peanuts grazed, do	99.7	80.6

It is evident that peanuts afforded a much softer lard than did sorghum, even when each constituted only about half the ration. The feeding of somewhat less than a half ration of mixed cotton seed meal and corn meal (1 to 4) for five weeks while peanuts were being grazed, failed to overcome the softening effects of peanuts.

In two experiments already recorded in this bulletin the body lard from pigs getting only peanuts melted at temperatures of 74.6 and 71.6 degrees Fahrenheit; the feeding of a small amount of a mixture of cotton seed meal and corn meal for five consecutive weeks while peanuts were being eaten in this test raised the melting point to 87.4 degrees, a gain of 12.8 and 15.8 degrees.

This increase of 12.8 to 15.8 degrees in hardness is somewhat greater than had previously resulted from feeding a stronger cotton seed meal mixture for six weeks after the peanuts were discontinued (see Experiment on p. 29.)

On the whole these experiments viewed together indicate that greater hardening effect results from the grain when fed with the softening food (as peanuts or chufas) than from that fed as the exclusive ration in the six weeks just before the date of butchering. This is also practically the conclusion reached by Bennett in Arkansas Bulletin No. 65.

COTTON SEED MEAL VERSUS COWPEA MEAL AND VERSUS  
CORN MEAL AS A FINISHING FOOD.

Six pigs from one litter which had subsisted for six weeks after weaning on a field of Spanish peanuts without any grain, were later divided into three lots and fed for 37 days (including the preliminary period of 7 days) as much as they would eat of the rations mentioned below:

*Food consumed and growth made in 30 days.*

	Food.	Grain eaten.	Growth made.	Lbs. grain per lb. growth.
		<i>Lbs.</i>	<i>Lbs.</i>	
Lot III	$\frac{1}{3}$ cowpea meal, $\frac{2}{3}$ corn meal....	95.3	19	5.00
Lot IV.	Corn meal .....	140 0	29	4.82
Lot V.	$\frac{1}{2}$ cotton seed meal, $\frac{1}{2}$ corn meal ...	92 0	16.5	5.57

All three lots made but slow growth, which we may attribute in the case of lots III and V to the relative unpalatability of the mixture containing either cowpea or cotton seed meal. Corn meal was more relished and hence in this brief experiment more satisfactory, though in previous experiments a mixture of cowpeas and corn has been superior to either alone, and especially so when the feeding period has been a long one.

EFFECTS ON HEALTH.

After 37 days' feeding of the 20 per cent. cotton seed meal mixture, No. 13, one of the pigs in Lot V, died after having appeared gaunt and weak for two days.

This death and the unthrifty appearance of the other

pig receiving cotton seed meal notified us that it was time for the experiment to close. The pigs in the other pens remained healthy. All were butchered as soon as the experiment was stopped, and samples of fat were taken and rendered into lard.

Up to the time of the death of one pig and the evident unthriftiness of another, the pigs in Lot V, averaging at the middle of the period 59.4 pounds per head in weight, had each consumed since the seventh of November 5.4 pounds of cotton seed meal. This is equivalent to saying that toxic effects were evident when for each 100 pounds of average live weight 9.2 of cotton seed meal had been consumed. During the experiment proper the average daily consumption of cotton seed meal was .25 of a pound per 100 pounds of live weight. It will be recalled that when the same mixture was fed in an earlier experiment to somewhat larger, but young shoats, the daily consumption of .41 of a pound per 100 pounds live weight resulted fatally. In a still earlier experiment with still larger shoats, cotton seed meal was consumed at the rate of .61 of a pound daily per 100 pounds of live weight, for 35 days; no immediate conspicuous injury resulted, and observations on subsequent effects were prevented by the disposition made of the pigs.

*Effects on quality of lard of small shoats fed on  
cowpea meal and cotton seed meal.*

Lot.	Pig No.	Food for last 37 days of life.	Food from Sept. 14 to Oct. 31.	Lard from kidneys Degrees F.	Lard from jowl. Degrees F.
.....	12	Peanuts alone.....	Peanuts [kil'd Oct.31]	82.6	68.2
III.	11	{ $\frac{1}{2}$ cowpea meal...	Peanuts....	81.5	72.0
III.	8	{ $\frac{3}{4}$ corn meal.....		79.9	72.5
III.	Av.	do	do	80.7	72.3
IV.	10	Corn meal, .....	do	88.3	78.8
IV.	9	do	do	77.2	72.4
IV.	Av.	do	do	82.7	75.6
V.	7	{ $\frac{1}{2}$ cotton seed meal	do	90.0	70.3
V.	13	{ $\frac{1}{2}$ corn meal.....		83.3	64.4
V.	Av.	do (died.)		86.7	67.4

The lard from all lots had a very low melting point for grain fed animals, probably due in part to small size and extreme immaturity of the pigs as well as to the softening effects of peanuts in an earlier period. We may safely discard the melting point of the jowl lard fat of Lot V, as probably being influenced by accidental conditions, possibly by variations in the percentage of moisture or other impurities left after rendering. Shutt has observed that unthrifty pigs have soft pork, which condition may constitute the explanation of the low melting points in Lot V.

The kidney lard was firmest when the cotton seed meal mixture was fed, the advantage in favor of this food being 4 degrees F. as compared with corn meal.

meal afforded a slightly firmer lard, both from and jowl, than did a mixture of cowpeas and meal.

Compared with the lard obtained from No. 12 (immediately after feeding peanuts), the cowpea meal mixture scarcely affected the melting point of the lard, but increased that of the jowl lard by 4.1 degrees F. respectively.

Cotton seed meal mixture raised the melting point of jowl lard 4.1 degrees F. above that of pure peanut oil and kidney fat.

Presently 37 days was too short a period for any of the foods to thoroughly harden pork once softened by peanuts. The tendency of our experiments and of those made by Bennett, in Arkansas, is to show the need of a longer hardening period than is generally regarded as necessary, or else the feeding of some grain while the peanuts are being consumed.

#### SEED MEAL MIXTURE VERSUS CORN MEAL—FOURTH EXPERIMENT.

Pigs which had grazed for 23 days on peanuts in the spring of 1902, were then penned and divided into two groups. One lot was fed on corn meal alone, the other on a mixture of three-fourths corn meal and one-fourth cotton seed meal. The average weight per shoat during the experiment was 136.3 pounds for those getting corn meal and 142.8 pounds for those on the cotton seed meal mixture. The amounts of food consumed by the two groups were practically identical. Omitting the preliminary period, the results for the next 28 days were as follows:

	<i>Daily growth per pig. Lbs.</i>	<i>Grain, per lb. growth Lbs.</i>
Corn meal.....	1 1	5 31
Cotton seed meal, $\frac{1}{4}$ corn meal ....	8	3 84

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In this experiment the rations containing 25 per cent of cotton seed meal caused much more rapid and economical growth than corn meal alone.

Throughout the 31 days during which cotton seed meal was fed the health of the shoats was good. The shoats getting the mixed rations consumed daily, per 100 pounds of mean live weights, .73 of a pound of cotton seed meal. Their total consumption of cotton seed meal in 31 days, including the preliminary period, was 22.6 pounds per 100 pounds of live weight.

Comparing this result with those previously recorded let us note the increasing amount of cotton seed meal per 100 pounds of live weight which may be safely fed as the pigs increase in size.

#### EFFECT OF COTTON SEED MEAL, CORN MEAL, AND RICE POLISH ON LARD.

In the following table are recorded the results of terminations, made by Mr. A. McB. Ransom of the Chemical Department, of the melting point of lard from the jowls.

The pigs were Poland Chinas from the same litter but were not butchered on the same date.

#### *Melting point of lard.*

		Food during 31 days before slaughtering.	Food from 35th to 32d day before slaughtering.	Melting point of bo- lar Deg.
Lot F.	No. 101	Corn meal.....	Peanuts & corn meal.	76.
"	No. 102	do	do	79.
"	Average	do	do	78.
Lot G.	No. 103	{ $\frac{1}{4}$ cotton seed meal, $\frac{3}{4}$ corn meal. ....	do	80.
"	No. 104	do	do	82.
"	Average	do	do	81.
	105	Rice polish [last 8 weeks]	Peanuts and corn meal [23 days]! . . . . .	74.
	106	Rice polish [8 weeks]	Grain ration . . . . .	78.
	107	Corn meal [8 weeks]	Grain ration . . . . .	85.
	108	Corn and skim milk *	Peanuts & corn meal, [23 days].....	76.

\*Only small amounts of skim milk were used and for only 19 days

In this test the feeding for 31 days of corn meal raised the melting point of lard (previously softened by peanuts only 3.8 degrees F. The feeding for the same time with a mixture containing 25 per cent. of cotton seed meal raised the melting point by 7.2 degrees F. The lard affected by the cotton seed meal ration was firmer than that from corn meal, the melting point of the former (34 degrees F.) being 3.4 higher.

This last result, together with other experiments detailed in previous pages, indicates that cotton seed meal has an appreciable value for hardening the lard. Subtly also the flesh of pigs raised on peanuts, cotton, and most other softening foods. This will be an important point in its favor when hog raising for home consumption, becomes an important industry in Alabama; for the buyer for a packhouse will not knowingly buy hogs with soft flesh. There is every reason why those sections of Alabama where peanuts thrive should at no distant date ship carloads of hogs to packing houses in Birmingham, Atlanta, New Orleans, or other markets, provided the flesh can be secured. In many counties the sale of hogs and their products could easily be made to bring in as much money as the cotton crop. Cholera is not an insurmountable obstacle. Keeping hogs off the public range, from flowing streams of cholera-infected water, a better understanding of the nature and means of spreading the disease, and judicious feeding and care, will greatly reduce this danger.

Hog raising requires little capital and brings its return quickly. Improved blood, food, care, and knowl-



edge are capable of making the Alabama hog, as well as his relative in the corn belt, a "mortgage lifter."

#### SWEET POTATOES FOR HOGS.

From November 13 to December 18, 1900, a period of 35 days, two shoats were penned on sweet potatoes growing on poor sandy soil, and furnished daily per head with 2 pounds ground corn and 1 pound ground cowpeas, which was regarded as a half ration. The total weight at the beginning of the test was 231 pounds and during the five weeks the two shoats made a total gain of 67 pounds, requiring besides sweet potatoes 3.13 pounds of grain per pound of growth.

The potatoes were not eaten with much relish, and after being rooted up they were left on the surface, some of them remaining there until they decayed. Probably the waste would have been less if less grain had been fed. The composition of the sweet potato leads us to expect that it would be advisable not at any time to confine shoats to sweet potatoes alone, but to give them while on the potato field a little nitrogenous food, such as cowpeas, peanuts, etc.

# CARTS VERSUS COWPEA MEAL VERSUS CORN MEAL.

period of seven weeks, in addition to a week of dry feeding, in January and February, 1899, and stuffs were compared, each being fed in conjunction with an equal weight of rice bran obtained from Co., New Orleans. There were three lots of reared pigs, each lot containing three pigs. All except one were from the same litter, and were all Berkshire—Poland Chinas.

Unusually cold weather of this time, inadequate food, and the rather unpalatable nature of all the feeds due to the admixture of rice bran, made the growth slow and unsatisfactory.

## Growth and food eaten in seven weeks.

Food.	Total growth, lbs.	Food eaten, lbs.	Lbs. food per lb. growth.
% corn hearts and 50% rice bran..	65	479.5	7.38
% cowpea meal and 50% rice bran..	80.6	478.5	5.95
% corn meal and 50% rice bran....	98.1	540.0	5.50

ration containing corn meal was the most effective, probably because of its greater palatability, and the larger amount consumed.

According to partial analyses made in the chemical laboratory here the rice bran used contained 9 per cent. protein, and the corn hearts 8.9 per cent. of protein.

## RICE POLISH AS A FOOD FOR PIGS.

The high price of corn during 1902 made it desirable to find some substitute in addition to such materials as are grown on the farm. Hence rice polish was employed in a number of experiments and was tested in conjunction with corn meal. In different experiments different proportions of foods were used alone or each combined with varying proportions of other foods. Each lot con-

sisted of three pigs, usually recently weaned. In a cases the food was fed dry.

*Rice polish versus corn meal in connection with skim milk.*—In the first experiment, made in the spring 1902, skim milk was fed in connection with either corn meal or rice polish. The results were as follows:

<i>Food.</i>	Growth, 3 pigs, in 5 weeks.	Lbs. grain per lb. growth.	Lbs. skim milk
Corn meal and skim milk.....	89.5	2.1	4.
Rice polish and skim milk.....	109.0	1.7	3.

It will be seen that in connection with skim milk, rice polish was more effective, pound for pound, than corn meal.

*Rice polish versus corn meal alone, first experiment.* At the end of the fifth week the skim milk was dropped from the ration of both lots and the rate and economy of growth were immediately greatly decreased, as shown below.

It then required to make one pound of growth 6 pounds of corn meal or 6.7 pounds of rice polish. In this test, in which the conditions were unfavorable for rapid gains, the rice polish and corn meal were of equal value.

*Rice polish versus mixed grain.*—The following test was made with a different litter of pigs just after weaning. The experiment covered, in addition to the preliminary period, five weeks, terminating June 11, 1902. There were three pigs in each lot.

The mixed grain consisted of one-half cowpea meal, one fourth corn meal, and one-fourth rice polish. This was fed in comparison with a grain ration of rice polish and the pigs of both lots receiving in addition a nearly equal amount of skim milk.

	Lbs. grain per lbs. growth.	Lbs. milk per lb. growth.
Lot B—Mixed grain and skim milk..	1.78	4.13
Lot C—Rice polish and skim milk....	1.93	4.74

be noticed that mixed grain consisting partly of corn meal, and hence very rich in nitrogenous material, was proved superior to rice polish.

*Polish in different proportions.*—During the next test the grain mixture for lot B remained the same, namely 50 per cent. cowpea meal, 25 per cent. corn meal and 25 per cent. rice polish.

The grain of lot C, was so changed as to consist of 50 per cent. of corn meal and rice polish.

At the close of the preliminary period the results were as follows:

	Lbs. grain per lbs. growth.
cowpea meal .....	
corn meal .....	5.0
rice polish .....	
corn meal .....	4.2
rice polish .....	

The test was made during mid summer and the pigs, being in small, bare yards and deprived of green food, did not make as rapid or as economical growth as they usually have done under more natural conditions. Ordinarily we should expect that for young pigs fed the nitrogenous mixture fed to lot B, would prove superior to the one as it did in the test described immediately above.

#### *Rice polish versus corn meal alone.*

During a third period of five weeks terminating August 1902, these same lots of shoats were used in a comparison of rice polish with corn meal, both foods being fed alone. The amounts of grain fed to the two lots were as follows:

	Lbs. growth 3 pigs in 4 weeks.	Lbs. grain per lb. of growth.
corn meal .....	53.5	5.01
rice polish .....	79	3.40

The daily rate of growth was much more rapid for the lot fed rice polish and these also required considerably less grain to make one pound of increase in live weight.

*Rice polish versus corn meal in mixed grain ration.*

A litter of six Poland China pigs, dropped April 2 1902, were divided into two lots and fed for five weeks on two lots of grain that were exactly similar except that rice polish in one was substituted for an equal percentage of corn meal in the other. The results of the last four weeks of the period follow:

		Lbs. growth.	Lbs. fo per 1 growt
Lot D	40% corn meal .....		
	40% cowpea meal .....	56	3.7
	20% wheat bran .....		
Lot E	40% rice polish .....		
	40% cowpea meal .....	65.5	3.1
	20% wheat bran .....		

Both of the above mixtures afforded satisfactory rate of growth, but the one containing rice polish was decidedly more effective than the mixture into which corn meal entered.

*Rice polish versus corn meal alone, third experiment.*

This experiment was made with two lots of three shoats each and extended over eight weeks, terminating October 1, 1902. The shoats used were the same as those employed in the last mentioned experiment.

	Lbs. growth in 8 weeks.	Total food in 8 weeks.	Lbs fo per 1 growt
Lot D—Corn meal .....	68	422.2	6.
Lot E—Rice polish .....	131.5	492.9	3.

The rate of growth was almost twice as rapid with the pigs fed on polish as for those consuming corn meal.

To make one pound of increase in live weight required in this experiment 39 per cent. less of polish than corn meal.

*Average results with rice polish.*

In most of the direct comparisons of rice polish with corn meal the polish proved decidedly superior.

Taking the average of all five of these direct comparisons we find that to produce one pound of increase in live weight of pigs required only 3.73 pounds of rice polish and 4.74 pounds of corn meal. At this rate 78

pounds of rice polish was equal to 100 pounds of corn meal, a saving of 21.4 per cent of the grain by the substitution of polish for corn meal.

The differences in composition are not such as to explain the superiority of the polish, but this may possibly have been partly due to the fact that the rice meal, a flour-like powder, was in a finer state of division than the corn meal.

*Composition of rice polish, rice meal and corn meal.*

*Figures from Henry's Feeds and Feeding.*

	Nitrogenous Matter.	Starch. etc.	Fiber.	Fat, etc.
Rice polish . . . . .	11.7	58.0	6.3	7.3
Rice meal . . . . .	12.0	51.0	5.4	13.1
Rice bran . . . . .	12.1	49.9	9.5	8.8
Corn meal . . . . .	9.2	68.7	1.9	3.8

We have had some difficulty in obtaining rice polish from states east of us, it being more profitable for the mills to mix it with other less valuable by-products and to sell the mixture of polish, rice, bran, etc., under the name of rice meal. Rice meal is of variable quality, according to the amounts of each by-product mixed in. Hence the figures quoted above need not be regarded as showing the composition of an average grade of rice meal.

As stated in a previous page we employed in one experiment rice bran mixed with an equal weight of several other foods. We found the rice bran mixtures unpalatable and the growth of pigs fed on it slow. At the South Carolina station rice meal, in connection with large amounts of skim milk, in a brief feeding period produced pork at less cost than when corn meal and skim milk were fed.

In November, 1902, rice meal was quoted to us by Planter's Rice Mills, Savannah, Ga., at \$17.90 delivered at Auburn, Ala., in less than carload lots. Rice polish bought from the same firm two years ago cost about \$26 per ton delivered at this station. It is of interest to note that a part of this rice polish kept in good condition for more than a year.

According to our experiments rice polish could with great profit be substituted for corn meal selling at the same price.

APPENDIX.  
*Percentages of internal organs, etc., as affected by food.*

	FOOD. 25 per cent cotton seed meal, 75 per cent corn meal.						FOOD. Corn meal alone					
	No. 88.			No. 90, female.			No. 85, female.			Essex Barrow.		
	Av. Nos. 88 & 90.									Av. Nos. 85 & Essex.		
	Weight lbs.	% live weight.	Weight lbs.	% live weight.	Weight lbs.	% live weight.	Weight lbs.	% live weight.	Weight lbs.	% live weight.	Weight lbs.	% live weight.
Date of butchering.....	Nov. 16.	Nov. 16.	Nov. 16.	Nov. 16.	Nov. 16.	Nov. 16.	Nov. 20.	Nov. 16.	Nov. 16.	Nov. 20.	Nov. 16.	Nov. 16.
Live weight.....	127	.....	117 00	.....	122	.....	135	.....	127 00	.....	131 00	.....
Blood.....	.....	.....	2 00	1 71	.....	.....	3	2 22	3 00	2 36	3 00	2 29
Dressed carcass, including head & feet.	103 5	81 4	93 00	79 5	98 3	80 55	111 5	82 65	96 40	76 10	103 95	79 37
Lungs.....	52	41	49	42	51	42	73	50	60	47	66	49
Liver.....	1 80	1 42	1 60	1 37	1 70	1 40	1 91	1 41	3 10	2 44	2 50	1 92
Heart.....	29	23	26	22	28	23	26	19	24	19	25	19
Kidneys.....	38	30	46	40	42	35	35	26	33	26	34	26
Spleen.....	09	07	10	09	10	08	12	09	12	09	12	09

The most significant differences attributable to the foods is the greater weight of kidneys and heart of the pigs receiving the more nitrogenous ration, and the greater weight of lungs (as in our former experiments) when the ration was highly carbonaceous.

No. 123.



Sci 1623.25,4

APRIL, 1903

**ALABAMA.**

# **Cultural Experiment Station**

**OF THE**

**CULTURAL AND MECHANICAL COLLEGE,**

**AUBURN.**

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## **Cowpea, and Soy Bean Hay as Substitutes for Wheat Bran.**

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**By J. F. DUGGAR.**

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**SMITHSON PRINTING CO., PRINTERS & BINDERS  
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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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# HORTICULTURAL LAW AND RULES PASSED BY THE BOARD OF HORTICULTURE.

## INTRODUCTION.

Years the horticultural interests in Alabama have suffered very much from the injury done by various injurious fungous pests. Most of the seriously injurious pests are distributed upon nursery stock from infested

The nursery trade is a legitimate one, and should be encouraged when honestly conducted. The introduction of the notorious San José scale has awakened to the fact that it is necessary to protect the planter from stock from infested nurseries. The method commonly adopted is to destroy nursery stock infested with pests, as dangerous to the public welfare, and order such stock destroyed. To do this all nurseries have to be examined several times each year, to see if there are no pests upon stock growing therein. If all the stock is healthy and of health is given, stating that the stock is entirely free from all such pests. Even with all this the planter should ever be on the lookout for injurious and fungous pests which may have escaped the attention of the inspector, or which may have gotten upon the plants after the time he made the examination. Many wide-awake fruit growers of Alabama have been trying to get adequate laws to aid them in regulating the industry in this State. This past winter the State Horticultural Society took action, and with the aid of others interested in the subject, succeeded in getting the Legislature to pass the following law:

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No. 121. Code of 1903.

AN ACT

To Further Protect Horticulture, Fruit Growing,  
. Truck Gardening, and to Exclude Crop Pests o  
Kinds in the State of Alabama.

SECTION 1.—*Be it Enacted by the Legislature of bama.* That from and after the passage of this act, Commissioner of Agriculture and Industries of the S of Alabama, the President of the Alabama State H cultural Society, and the Director of the Experin Station of the Alabama Polytechnic Institute shall officio, constitute a board to be known as the S Board of Horticulture, of which the Commissione Agriculture and Industries shall be chairman, w board shall have full power to enact such rules and n lations governing the examination, certification, transportation and introduction of trees, shrubs, tings, buds, vines, bulbs, and roots, that they may c necessary to prevent the further introduction, incr and dissemination of insect pests and plant diseases.

SEC. 2.—That the Professsor of Horticulture of Alabama Polytechnic Institute shall act as State H culturist and as secretary of said Board of Horticul under the provisions of this act, and it shall be the of the said board to promulgate rules and regulation accordance with this act for the government of the State Horticulturist in the duties devolving upon hi execution of the provisions of this act.

SEC. 3.—There is hereby annually appropriated sum of (\$1,500) fifteen hundred dollars, to be disb under the direction of the Board of Trustees of the bama Polytechnic Institute for the purpose of defra the expense in the execution of this act.

SEC. 4.—The State Horticulturist or a deputy

by the Board of Horticulture, shall have under the regulations of the Board of Horticulture any section of the State where such pests are to exist, and to determine whether any infested plants are worthy of remedial treatment or shall be destroyed, and he shall immediately report his findings, giving reasons therefor, to the owner of the plantation, his agents or tenant, and a copy of the report shall also be submitted to the said board. If objections to the findings of the State Horticulturist or his deputy, an appeal shall be made to the court, who shall have power to summon witnesses and take testimony on oath, and whose decision shall be final. An appeal shall be taken within ten days and shall stay a stay of proceedings until it is heard and decided.

—Upon the findings of the State Horticulturist or his deputy in any case of infested trees or plants, the treatment prescribed by him shall be executed (unless an appeal is taken), under his supervision. The cost of material and labor shall be borne by the owner; provided, however, that in case the trees or plants shall be condemned they shall be destroyed by the State Horticulturist, and the expense of such action shall be borne by the owner. No compensation shall be made for any plants that shall be destroyed.

—In case any person or persons refuse to obey the direction of the State Horticulturist or of the Board upon an appeal, a Justice of the Peace or Judge of the county shall, upon complaint filed by the State Horticulturist or any freeholder, cite the persons to appear before him within ten days after notice being served, and that the said judge upon the evidence shall cause the prescribed treatment to be executed, and the expense thereof and cost of

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court shall be collected from the owner or owners of infested plants.

SEC. 7.—It shall be unlawful to offer for sale, give away or transport perennial plants, scions, buds, trees, shrubs, vines, or other plants, tubers, roots, cuttings, bulbs, known to be infested with dangerously injurious insects or plant diseases. Any person or persons violating this section shall, upon conviction, be fined not less than ten nor more than one hundred dollars for each separate offense.

SEC. 8.—The said Board of Horticulture, its agents or employees, are hereby empowered with authority to enter upon any premises in discharge of the duties herein described. Any person or persons who shall obstruct or hinder them or their agents in the discharge of their duties shall be deemed guilty of a misdemeanor, and upon conviction therefor, shall be fined not less than ten nor more than one hundred dollars.

SEC. 9.—The Board shall have the power also to adopt rules and regulations, not inconsistent with the laws and constitution of this State and the United States, for preventing the introduction of dangerous and injurious crop pests of all kinds from without the State, or regarding the dissemination of crop pests within the State, and for the governing of common carriers in transporting plants liable to harbor such pests, to and from and within the State, and such regulations shall have the force of laws.

SEC. 10.—Be it further enacted, that the members of said Board, any two of whom shall constitute a quorum, in the absence of the third, shall, within thirty days after the passage of this act, and from time to time, draw up and promulgate through the press of the State the rules and regulations necessary to carry into full and complete effect the provisions of this act, carefully defining

ases or maladies, both insect and fungus, shall e infection in trees or plants, within the and purview thereof.

.—It shall be unlawful for any person, firm or on to sell, give away, or ship within the State na any trees or shrubs or any other plants com- own as nursery stock, without having a certifi- arantee of the State Horticulturist of Alabama. f such certificate of guarantee must accompany or package sold, given away or shipped. Such e must be dated within twelve months. If upon ion such stock is found to conform to the re- ts of the said Board of Horticulture, the State urist must furnish a certificate to that effect. on or persons selling, giving away or shipping stock without the certificate of the State Horti- shall be fined not less than fifty nor more than red dollars.

.—Each and every person, firm or corporation and doing business outside of the State of Ala- aling in or handling trees, shrubs or other plants y known as nursery stock, shall file a copy of certificate of his or its inspection furnished by Horticulturist, nursery inspector or other duly d official of his or its State or county with the of the Board of Horticulture. Upon the filing rtificate as above prescribed, and upon request son, firm or corporation, a certificate will be is- he same, and official tags bearing copy of such e and seal of the Board will be furnished the ost, provided, however, that the aforesaid certi- nspection shall be adjudged satisfactory by the Each box, bundle or package of nursery stock nto Alabama by any person, firm or corporation r one of these tags, and shipments of stock not

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thus tagged shall be liable to confiscation by the Board of Horticulture through its agents or employees.

SEC. 13.—No transportation company or common carrier shall deliver any box, bundle or package of trees, shrubs or plants commonly known as nursery stock to any consignee residing within the State of Alabama when said box, bundle or package does not bear the official tag or certificate of guarantee issued by the State Horticulturist without previously notifying the State Horticulturist of the particulars of the shipment as may be required by the Board, nor without duly warning the consignee of his risk in accepting said shipment. Failure on the part of any transportation company or common carrier to conform to these requirements shall be deemed a misdemeanor, and shall be punishable in each instance by a fine of not less than ten nor more than fifty dollars. Provided, that no common carrier shall be liable for damages to the consignee or consignor for refusing to receive, transport, or deliver such trees, packages, or boxes, when not accompanied by the tag or certificate herein provided.

SEC. 14.—Any person, firm or corporation receiving from any other firm, or corporation, any box, bundle or package of trees, shrubs, or plants commonly known as nursery stock, which is not accompanied by a certificate of guarantee, or official tag issued by the State Horticulturist to cover said stock, shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined not less than ten nor more than one hundred dollars.

SEC. 15.—It shall be the duty of the State Horticulturist to make a quarterly report of his work, and of the expenditures under this act to the Board of Horticulture, and said Board shall report annually to the Governor of the State.

Approved March 5, 1903.

Official:

J. THOS. HEFLIN,  
*Secretary of State*

## THE BOARD OF HORTICULTURE.

As provided by the above law the following persons  
ex-officio members of the Board of Horticulture:

The Commissioner of Agriculture and Industries,  
Chairman.

The Hon. R. R. Poole, Montgomery.

The President of the Alabama State Horticultural So-  
ciety.

Mr. W. F. Heikes, Huntsville.

The Director of the Experiment Station, Alabama  
Mechanic Institute,

Prof. Chas. C. Thach, Auburn.

The Professor of Horticulture of the Alabama Poly-  
technic Institute, to be State Horticulturist and Secre-  
tary to the Board.

Prof. R. S. Mackintosh, Auburn.

The Board of Horticulture met at Auburn, March 20,  
1907, and in accordance with Section 10 of the above  
law the following insects and fungous diseases were con-  
sidered dangerous and to constitute infestation in trees  
and plants:

1) San Jose Scale, (*Aspidiotus perniciosus*.)

2) The New Peach Scale, (*Diaspis amygdali*.)

When found in a nursery all infested stock to be  
destroyed. If San José Scale is found in the immediate  
neighborhood, all stock must be fumigated or certificate  
must be withheld.

3) Black Knot, (*Plowrightia morbosa*.)

4) Crown Gall, (*Dendrophagus globosus*.)

When found in a nursery all diseased stock to be de-  
stroyed, otherwise stock may be shipped.

5) Peach Yellows.

6) Peach and Plum Rosette.

All infested trees and nursery stock to be destroyed.



(7) Woolly Aphis, (*Schizoneura lanigera*.)

All badly diseased stock to be destroyed. Other stock to be fumigated or treated with kerosene emulsion.

## RULES.

The following rules and regulations were adopted:

Rule 1.—The State Horticulturist is hereby charged with the enforcement of this act, and is directed to locate by personal visits, by correspondence or in such other manner as he may deem best, to locate the above named pests, so far as they exist in this State, and to take such action, in accordance with the above act, as he may deem necessary to control or eradicate the same.

Rule 2.—The State Horticulturist shall have power to require all nursery stock sold within the State of Alabama to be treated with hydrocyanic acid gas, when in his judgment the presence of any pest requires it, for the better protection of the interests of the citizens of the State. Upon the failure of any individual, firm or corporation to comply with this, the State Horticulturist is hereby authorized to withhold his certificate.

Rule 3.—All certificates of examination shall expire prior to July 15th of the year after date of issue.

Rule 4.—All nurseries are to be examined between July 15th and November 15th of each year.

Rule 5.—Definition of Nursery Stock.—In addition to fruit trees, the following if offered for sale are classified as nursery stock, and are subject to the regulations governing the examination and transportation of the same: Strawberry plants, vines, ornamental trees and shrubs. (Including field grown roses.)

Rule 6.—All appeals from the decisions of the State Horticulturist should be addressed to the Chairman of the Board of Horticulture, at the Capitol, Montgomery, Ala.

le 7.—All communications relative to the examination of orchards and nurseries should be addressed to State Horticulturist, Auburn, Ala.

le 8.—A deputy duly authorized by the Board of Agriculture shall have the same power and authority as the State Horticulturist in carrying out the provisions of this act under the direction of the State Horticulturist.

It is not the intention of the Board nor the State Horticulturist to cut down and destroy orchards unless the case absolutely demands it, but rather to use some remedial treatment if possible. It will be the aim to see that the nursery stock sold in this State is free, or supposed to be free, from all seriously injurious pests. To make this law most effective everyone interested should carry out the provisions of the law and to report promptly all cases of the violation of the law by any one. The purchasers of nursery stock are requested to read section 14, of the law, which makes it a misdemeanor for anyone to receive any nursery stock not provided with a certificate or official tag authorized by the State Horticulturist to cover such stock.

## NOTES ON SOME OF THE INSECTS AND FUNGUS DISEASES AFFECTING HORTICULTURAL CROPS.

Only the insects and fungous diseases enumerated by the Board of Horticulture, as very dangerous pests here described, and while they do not represent all that injure our horticultural crops, yet, they do represent the more dangerous ones.

The good old adage "an ounce of prevention is worth a pound of cure" must be our motto, for, in fact, the foundation on which our Horticultural Law is based is, i. e., to examine all nursery stock so as to keep out various insects and fungous pests.

Unfortunately the San Jose scale is found in many parts of Alabama. It was brought here on nursery stock from infested localities, and there is no hope of eradicating our state of this scale, but with the earnest efforts of the various growers, we should be able to keep it from spreading farther.

The State Horticulturist is ready to do all he can to help in preventing the spread of the various pests on nursery stock, and to aid the owners of infested grounds to rid their premises of them.

*Recommendations.*—The best, as well as the most practical way of treating nursery stock, is to fumigate it with hydrocyanic acid gas. This is usually done by the nurseryman before the stock is packed for shipment. It should not be considered as an entirely safe remedy, but, rather, as one of the safeguards to use in securing clean stock. All growers should be continually on watch for the first indication of any trouble foreign to the natural growth or habit of plant or tree.

After the trees have been pruned and ready to be planted, they may be dipped in the lime, sulphur and salt solution for a moment. This covers the trunk and branches with this insecticide, and should destroy all of the living scales.

*Caution*—In doing this only dip the top, do not submerge the roots, and do not treat at all when the buds have started. Fumigation or dipping can only be done when the trees are dormant, never after growth has started.

With one or both of these precautions, and then only setting the stock from regularly inspected nurseries, could practically guarantee trees free of any of the above named pests.

*Orchard treatment.*—When the scale is discovered in an orchard, all badly infested trees should be dug up and burned. These trees will be killed in a comparatively short time, from the injury caused by the scale, and besides, the owner is free from this source of infection. In the end it is a saving rather than a loss.

Undoubtedly the best remedy that we now have is the lime, sulphur and salt wash. This has been tried in a great many places, and has been found very successful in controlling scale insects. While it cannot be expected to kill all the scales at once, yet it kills the larger part of them, and helps to successfully keep them under control. To be effective the lime, sulphur and salt wash must be carefully made, and in spraying every part of the tree, from the ground up, must be covered. It is advisable to go over the trees a second time in order to cover parts overlooked the first time.

Spraying at best is laborious and disagreeable work, and unless done thoroughly and at the proper time, is little better than if not done at all. This wash can only be applied to the trees in winter time, as then the trees are dormant. It seems that the best time to apply it is just before the buds open in the spring.

So far no successful summer treatment has been found. As mentioned above, all badly infested trees should be destroyed and all others not so badly infested should be treated by covering the trunk and larger branches with the lime, sulphur and salt wash. Use one-half the regular strength, and apply by either a brush or spray pump. Be careful not to get too much on the foliage, although it is better to sacrifice some of the foliage rather than not to touch the larger part of the scales.

*Spraying Outfits.*—Too much can not be said in favor of having strong and effective spraying outfits. A small leaky pump, with only a few feet of hose, and a wornout nozzle are not the proper things to use in spraying trees. It is much better for several congenial growers to unite in purchasing a good, serviceable outfit, rather than for each to purchase smaller and less efficient apparatus.

THE SAN JOSE SCALE, (*Aspidiotus perniciosus*)  
Comstock.

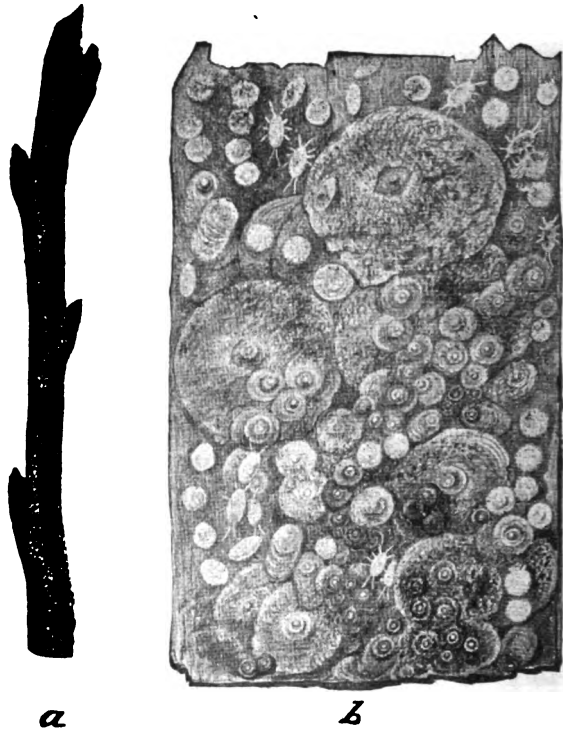


Fig. 1.—Appearance of scale on bark: *a*, infested twig, natural size; *b*, bark as it appears under hand lense, showing scales in various stages of development, and young larvae. (Howard A. Marlatt, Bul. No. 3, New Series, Div. of Entomology, U. S. Department of Agr.)

*How to detect it.*—This scale is very small and is rather difficult for an inexperienced eye to detect. Roughly speaking, it is about the size of a pinhead.

The description of the San Jose scale; New Peach scale; Knot; Peach Yellows and the Peach and Plum Rosette are by W. M. Scott, State Entomologist of Georgia; and those of Woolly Aphis and Crown Gall are by Prof. S. A. Forbes, Entomologist of Illinois.

hand lense the female is dark gray in color, circular in outline, and terminates at the central nipple like prominence, surrounded by a disc. The male scales are elongated and smaller, with a nipple near the anterior end. The real insect beneath the scaly covering is plump, circular in outline, yellowish. If crushed with the point of a knife the scale gives out a pale yellowish liquid. The newly-born young are minute mite-like creatures, long oval in shape, of a bright orange color. They are quite active in seeking a dark spot on which to settle, and in a few hours they are anchored themselves with their beak for life; in the case of the males, which issue at maturity and become active again.

A tree becomes crusted over with these scales and has the grayish appearance of having been covered over with dampened ashes.

**Plants.**—The San Jose scale may be looked for on the following plants: Peach, plum, apple, pear, cherry, quince, almonds, rose, Hawthorn, spiraea, cotoneaster, prunus pissardii, strawflowering quince, mountain ash, gooseberry, flowering currant, grape, English walnut, peck walnut, persimmon, elm, osage orange, linden, weeping willow, Kilmornock willow, golden willow, cotton-wood, Lombardy Carolina poplar, catalpa, sumach, silver maple, and many others.

**Prevention.**—For nursery stock, fumigation with cyanide gas in an air-tight room is the only remedy; and, in fact, this treatment cannot be considered an absolute surety against the scale, since some opening in the house may allow the gas to escape before it has done its deadly work. Where trees are generally known to be infested they should never be burned. There is too great a risk of loss of infested stock, no matter to what treatment they may have been subjected. Fumigation is a good remedy, and every nurseryman should fumigate his stock not only on account of the probable existence of this nursery pest, but also on account of other insects usually present on nursery trees to a greater or lesser extent. This work of fumigation is accomplished

by packing the trees in a *air-tight* room and subjecting them to the fumes of hydrocyanic acid for thirty minutes. The gas is generated by treating chemically pure potassium cyanide with the best grade of commercial sulphuric acid at the rate of  $1\frac{1}{4}$  oz. of cyanide to 1 oz. of acid and 5 oz. of water to every 150 feet of space in the room.

#### PRELIMINARY TREATMENT.

Unfortunately there seems to be no satisfactory summer treatment for the San Jose scale, and winter applications must be chiefly depended upon for the control of this pest. However, it is not infrequent that summer spraying can be done to advantage. This insect multiplies at a rapidly increasing ratio during the breeding season until checked by cold weather about the middle of November or later. In this climate, therefore, the period of greatest reproduction among the scale insects, and consequently of greatest damage to the infested trees, is from about the middle of September to the middle of November. Trees that are only slightly infested in July may become encrusted with scales by November. Frequently this rapid fall multiplication of the scale, if left unchecked, results in the death of a great number of trees before a winter wash can be applied.

The value of late summer or fall spraying in checking the progress of the scale has been determined not only by our experiments, but also by practical work in large orchards. A 10 per cent. strength (or even 15 per cent. when carefully used) of kerosene or crude oil applied in mechanical mixture with water, or in soap emulsion, does not materially damage peach trees in foliage, but does destroy large numbers of scale insects, especially the recently issued young and a considerable percentage of the breeding females. During the breeding season the progress of the scale should be watched, and if it threatens to kill or impair the infested trees before winter sets in, two or three applications of oil should be made. These may be made at intervals of two or three weeks, as occasion seems to demand, but even two applications on successive days or with one day intervening, are considerably more effective than a single one. The trunk and larger limbs should be thoroughly sprayed,

renching of the foliage should be avoided as much as possible. The oil has a tendency to scorch the foliage, but not to a serious extent if the work is properly done.

## HOW TO PREPARE THE SPRAYING MATERIALS.

### KEROSENE OIL EMULSION.

*Formula and Directions.*—An emulsion of either crude petroleum or kerosene may be made from the following formula:

- 2 pounds potash whale-oil soap.
- 4 gallons water.
- 8 gallons oil.

Weigh the soap carefully and place with the water in a vessel over the fire, using a slight excess of water to make up for evaporation. Fit a pump with a short piece of hose, to which is attached a nozzle for throwing a straight stream 3-16 or 1-4 inch in diameter. Pour the oil into the barrel or tub in which the pump is set, and when the whale-oil soap is dissolved, and the solution begins to boil, add it to the oil, and pump the whole vigorously back into itself for a period of at least ten minutes. The stream from the nozzle should be directed straight downward into the mixture so as to stir it to the very bottom. After a few minutes the oil and soap solution will be seen to combine, forming a thick, creamy emulsion, which when perfectly made will remain without change for weeks.

For a 20 per cent. strength add water to make 40 gallons.

For a 15 per cent. strength add water to make 53 1-3 gallons.

For a 10 per cent. strength add water to make 80 gallons.

*Materials and Pump Required.*—Either crude oil or kerosene will give good results in making emulsion. The soap should preferably be some soft whale-oil soap, such as Good's No. 3. If a hard soap is used the emulsion will be curdy, and only with difficulty mix with water.

The ordinary Bordeaux spray pump answers very well for mixing the emulsion, but almost any pump will do. A "Bordeaux" or "Seneca" nozzle gives a very fine spray that can be fitted with the requisite section of hose and



satisfactory sized stream for this work, though rather small.

The water used must be soft, for if hard no stable emulsion can be prepared, and it sometimes happens that foreign substances chancing to be present, will prevent the emulsification. In case limestone or hard water is to be employed, it should be broken by the addition of a small quantity of lye. If a lot of soap solution and for any reason, fails to emulsify properly, the best thing to do is to throw the whole away, carefully clean up the pump, wash out all the vessels used and begin over.

*Properties of the Emulsion.*—The emulsion, if well made of the proper soap, will retain its creamy consistency when cold, and is easily mixed with water in any proportions. No alarm should be felt if a small portion of the soap and water fails to emulsify, and separates to the bottom, nor, if after being exposed to the air for some time, a thin scum forms over the surface. If on long standing globules of free oil rise to the surface, or a thin ring of oil collects around the sides of the containing vessel, the emulsion should either be thrown away or warmed up and agitated afresh.

When diluted the emulsion may slowly rise, forming a cream, to the surface, and in order to prevent this a spray pump in which it is to be used should be provided with an agitator.

Never try to boil the kerosene over the fire; it is unnecessary, and besides it is very dangerous.

## THE LIME, SULPHUR AND SALT WASH.

### FORMULA AND DIRECTIONS.

This wash may be prepared by combining lime, sulphur and salt in several different proportions, but the following appears to be the generally accepted formula.

Quick lime .....	30 pounds
Salt .....	15 pounds
Flower of sulphur .....	20 pounds
Water to make 60 gallons.	

Slake half the lime carefully and place it in a large kettle with 25 gallons of water; grind the sulphur with a little water, breaking the lumps as fine as possible by passing through a sieve and add to the lime; b

When it boils the liquid will gradually become thinner and thinner, the lime and sulphur dissolving simultaneously to form a deep orange-red solution. When the sulphur is apparently all entered into solution, which may take two hours or more, slake the remainder of the lime, add to it the salt, and pour the two into the lime and sulphur solution. Boil the whole for from half an hour to an hour longer, strain, and dilute with warm water to 60 gallons. Do not let it become thoroughly cold, but use it while yet warm.

The principal care in making up this wash is to make sure that the sulphur is thoroughly dissolved. Flowers of sulphur is apt to be more or less lumpy, and these lumps are very difficult of solution. The more thoroughly the sulphur is ground up with water before being boiled with the lime, the less time it will take in the boiling.

An iron kettle must be used if the boiling is done directly over a fire. A better and cheaper way, whenever a head of steam is available, is to place the sulphur, lime and salt together in a barrel half full of water, conduct the steam through a pipe to the bottom of the barrel and boil it for two or three hours, with occasional stirring, making sure that nothing is settling. If a boiler is convenient, a pipe must be so arranged as to conduct steam to a number of barrels at once.

#### NEW PEACH SCALE. (*Diaspis amygdali* Tryon.)

*How to detect it.*—This scale is readily distinguished from the San José scale in that the female is a little larger, of a lighter gray color, with the elongated excuvial point ridged and located at one side of the center, and the male is smaller, elongated, with parallel sides and white. The excuvial point is similar to that of the male, but located at the anterior end. A tree badly infested has a white-washed appearance from the color of the male scales. Where only females occur, however, a grayish brown appearance is produced.

It is the habit of these insects to cluster about the trunk and the lower parts of the larger limbs of a tree. The original home of this insect is probably either the West Indies or Japan. From its probable West In-

dian origin it gets one of its popular names, "West  
dia" scale.

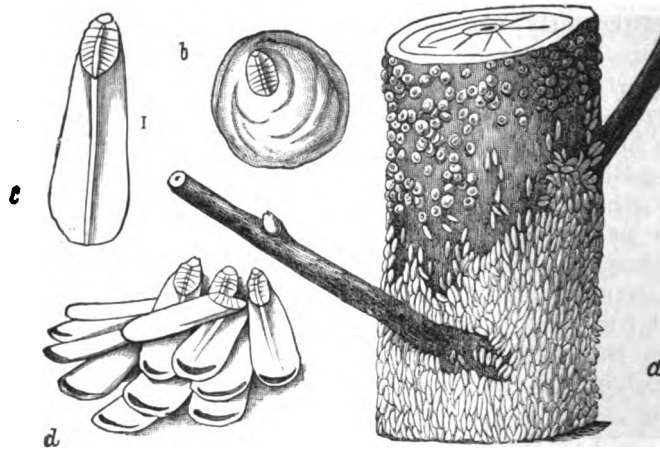


Fig. 2.—The New Peach Scale: *a*, branch covered with male female scales, natural size; *b*, female scale; *c*, male scale; *d*, of male scales—enlarged. (Howard, U. S. Dept. of Agr., Year 1894.)

It attacks the peach, plum, apricot, cherry, grape, persimmon, and a few other plants.

*Treatment.*—The winter treatment for this insect is about the same as that for the San José scale. The male pass the winter in the mature and partially mature state, and can be killed by the lime, sulphur, and salt wash, or by the whale-oil soap treatment at the rate of one pound dissolved in one gallon of water. In Georgia there are three or four broods from eggs, which appear at more or less regular intervals, the first appearing about the middle of March if the season is favorable. These broods should be watched for and ten per cent. kerosene or whale-oil soap at a rate of one pound to four gallons of water should be applied at the time of their appearance.

It is becoming one of the most dangerous pests

which we have to contend, perhaps equal to the San José scale. The most vigorous measures should be adopted for its eradication while it is yet in its incipency.

**BLACK KNOT.** (*Plowrightia morbosa* Sch.)



Fig. 3.—Black Knot.—Old knots on cherry twigs, natural size. (Scott, Bul. No. 1, Georgia State Board of Entomology.)

Plums and cherries are subject to the attacks of a disease very expressively termed "Black Knot." This dis-

case is American in its origin and occurs more or less abundantly throughout the United States, but is especially prevalent in the Eastern States, where it is supposed to have first appeared. In some sections of the country growers of plums and cherries have been forced from time to time to abandon the industry in consequence of the ruinous effects of its work. Cases are on record showing that orchards that paid handsomely one year were completely destroyed the following year or two.

The more intelligent growers are fully aware of the injuries they are liable to suffer from its attacks, and whenever it appears on their premises they lose no time in removing it by cutting off affected parts or roots and pulling up the diseased trees. Through such wise measures the disease has not been allowed to get beyond control.

*How to detect it.*—Some fully formed knots are illustrated in figure 3. These are large, rough, blackish swellings, due to the growth of a fungus (*Plowria moribosa*) in the cambium layer of the branches or trunks. These crusty enlargements may extend entirely around the branch or grow lengthwise on one side. The swelling usually begins in the spring, when the sap begins to flow; it may, however, occasionally be noticed in the fall. The first indication is a slight enlargement, usually longitudinal, which rapidly increases in size as the season advances. The bark is soon ruptured and finally scaled off, exposing a yellowish brown crusty surface. In May the fungus bears a crop of infectious spores on the surface of the knot, which gives it a velvety appearance. These spores are soon scattered by the wind or other natural agencies furnishing infection for other trees and thus disseminating the disease. The knot then becomes hard and black as fall is approaching.

It has not yet completed its work. During mid-winter another crop of spores is produced and scattered. These gain lodgment in the cracks and crevices of the bark and in the forks of twigs and at the growing points, ready to germinate and penetrate the tissues of the bark as spring opens up.

*Treatment.*—The most effective method of controlling this disease is to cut out all the knots as soon as they appear and burn them. This work should be supplemented by spraying with Bordeaux (four pounds of copper sulphate and five pounds of fresh lime to fifty gallons of water). Four applications are necessary, two for the winter crop of spores and two for the summer crop. The first should be made about two weeks before the buds begin to open, and the second immediately before they open. The third application should be made about the middle of May at the time the summer crop of spores is produced, followed in about two weeks with the fourth.

All wild cherry and plum trees should be carefully watched, as they are frequently badly attacked, and affected parts must be cut away and burned.

#### THE CROWN GALL. (*Dendrophagus globosus*.)

This is a dark, rough, abruptly protruding tumor growing most commonly from the crown of the tree, and varying in size from that of a pea to that of the fist, or larger—the latter usually on old and long infested trees. A badly affected tree is likely to show signs of starvation, its growth ceasing and its foliage having a sickly yellow look. Young trees often perish from this disease, which is certainly contagious in some forms and perhaps in all, and even large orchard trees may die and finally break off at the base of the trunk.

Although much the most common above the crown, just below the surface of the ground, this gall frequently grows on the larger roots, and is sometimes seen exposed on the trunk. Appearing at first as a simple lump or tubercle, it may so extend its growth as to girdle the trunk with its large wart-like excrescences. Young galls while still fresh have at first the color of the roots from which they grow, but later darken from the accumulation of dead bark on their surfaces. They are at first, while very small, softer than the healthy tissue of the root, but harden with age, and their inner structure be-

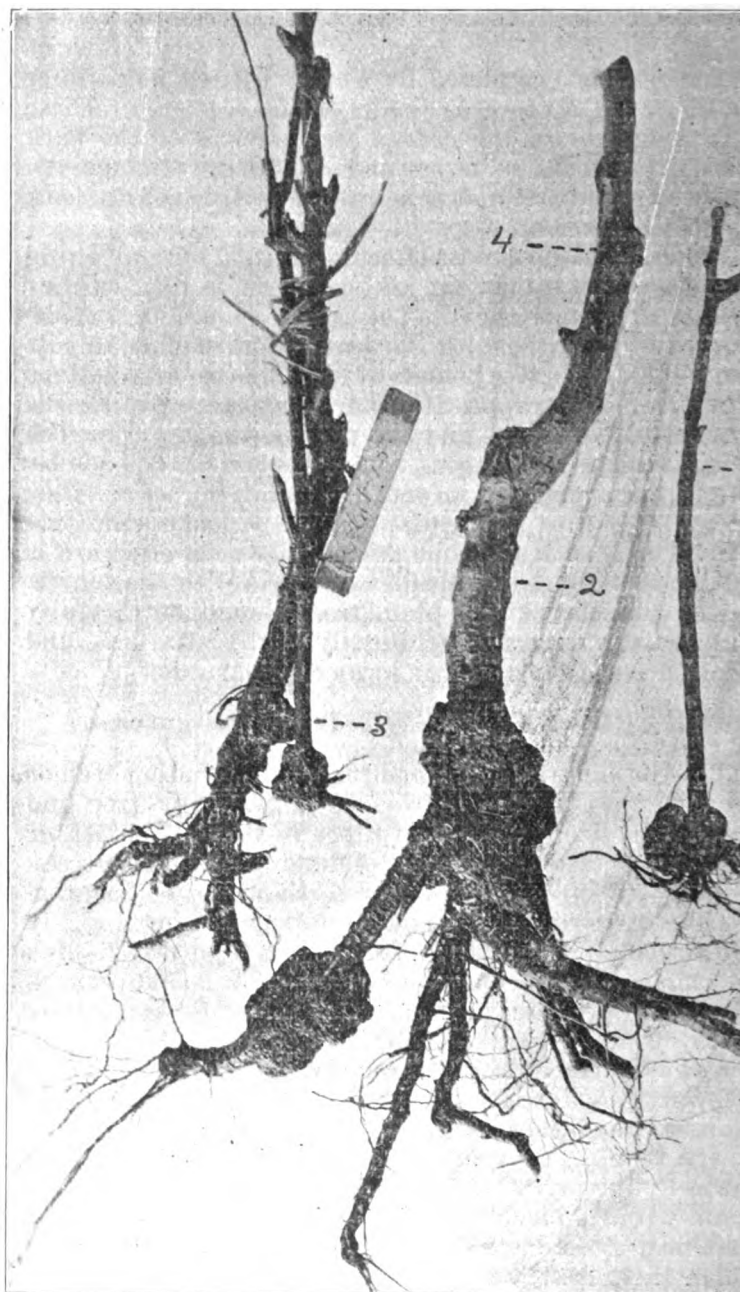


Fig. 4.—Crown Gall. 1, gall on Mariana Plum cutting; 2, gall at crown and on root of Elberta Peach; 3, gall on Peach induced by planting diseased Mariana Plum in juxtaposition; 4, gall induced by inoculation. (Quintance, Report Georgia State Historical Society, 1900.)

irregular and confused. On old galls, soft, white, the points appear here and there in early spring, enlarging rapidly, become gradually darker and, and by fall take on the appearance of the older galls.

There is much evidence that the crown-gall of the apricot and almond is a contagious disease due to a minute parasitic organism (*Dendrophagus globosus*) belonging to a peculiar group of fungi known as "slime moulds," but this conclusion has not yet been fully verified for the apple, the pear, the raspberry, the peach, for any other of the numerous kinds of fruit trees and shrubs on which similar wart-growths have been observed.

Experimental work now in progress has been carried far as to warrant conclusions on this point, that crown-gall of the apple, now extremely common in the nurseries of the Mississippi valley, can be regarded as a suspicious object, and not certainly as a danger. But the careful nurserymen, jealous of his reputation, will not send out even suspected material and in doubtful cases will give his customers benefit of the doubt. On this account I strongly advise that no stock of any kind showing galls of this sort on the crown, root or trunk should be placed on the market. All trees growing in close contact with those affected should have their roots dipped in Bordeaux as a precautionary disinfectant, and the ground on which the stock so diseased has grown should be temporarily stock for some other purpose than that of raising fruit stock.

#### PEACH YELLOWS.

This is of American origin, and has been known for more than one hundred years. It is quite generally distributed over the Eastern States north of Tennessee and North Carolina. Some of the most important peach sections of the East have suffered immensely from its development, and in not a few cases entire orchards have been completely destroyed. It seems to prefer peaches, but apricots, almonds, nectarines and Japanese plums are not free from its attacks.

*How to detect it.*—If the affected trees are in bearing, the first symptom is manifested in the premature ripening of the fruit, which may take place several weeks or



only a few days before the normal season of ripening. Premature ripening may be due to other causes, but yellow peaches bear characteristic bright-red, blotches over the skin and streaks of red through the flesh often reaching to the pit. Another reliable symptom is the pushing out of newly formed buds at the ends of apparently healthy twigs or water sprouts, into shoots with small yellowish leaves. Such buds are not normally put out until the following season. In the case of the disease may cause dormant buds on the trunk and larger limbs to push into feeble, often branched shoots characterized by narrow stiff leaves. This stage is illustrated in figure 5, showing the abnormal growth of a tree dying with the yellows. Affected trees may live three to five years, during which time they are gradually weakened and finally the foliage becomes yellow and reddish in color.

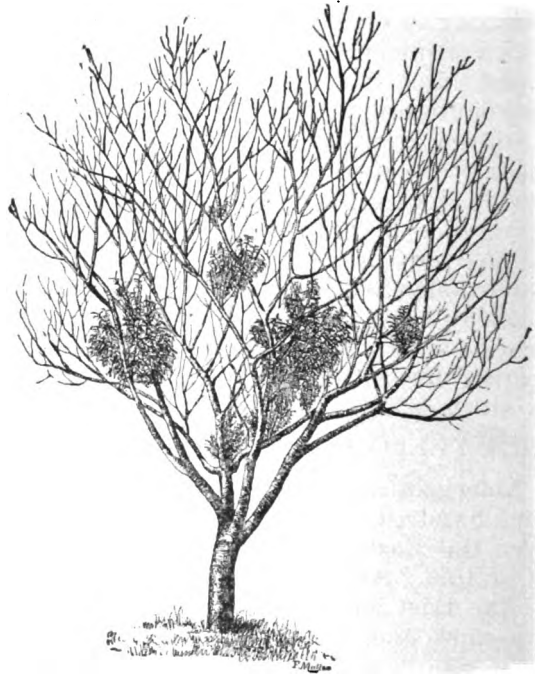


Fig. 5.—Yellows the fourth year. (Smith, Farmers' Bul. U. S. Dept. Agr.)

The term "yellows" is somewhat misleading. Quite a number of supposed cases of yellows in this State have been reported to the writer, but, upon investigation

flowing of the foliage in every case proved to be due to the peach borers, drouth or some other weakening effect on the trees. Premature ripening of the fruit from similar causes has also lead many to believe their trees to be affected with the yellows. The absence of red spots on the skin and red streaks through the flesh of the fruit would serve to relieve uneasiness in such cases.

The cause of yellows is yet undetermined, but it is definitely known that it is a disease and can be communicated from tree to tree and from orchard to orchard. Experiments have shown that it can be communicated to healthy trees through buds taken from diseased trees, but the manner of its natural spread from tree to tree is not unknown. It is known, however, that from scattered trees in the orchard it will gradually spread over the entire orchard and completely destroy it if left unmolested.

*Prevention.*—Since yellows is an incurable disease, we can only look to preventive measures for protection.

(1) Peach trees should not be obtained from nurseries located immediately in infested sections. Such stock is liable to develop yellows after planting out.

(2) Peach pits from affected trees should never be planted. They may reasonably be expected to convey the disease to the young stock.

(3) Whenever the disease appears in an orchard every affected tree should be rooted up and burned. Simply cutting off affected parts is not sufficient. The virus exists in the apparently healthy parts and would soon develop the symptoms of yellows. The whole tree, root and branch, must be destroyed.

## PEACH AND PLUM ROSETTE.

Similar to the yellows is a disease known as "Rosette" from the peculiar tufts into which the leaf buds grow on trees under the influence of the disease. It attacks peaches and plums and is quite generally distributed over the northern portion of Middle Georgia, extending from Augusta to the Alabama line, and from Macon to some distance north of Atlanta. The writer has quite thoroughly worked the State over and has never found it south of Macon nor in extreme North Georgia. It also occurs, although to a limited extent, in Eastern Kansas and in Western South Carolina. It seems to be most

prevalent in Georgia,, where it has been known for twenty years. It causes the destruction of many annually in infested sections of this State, but the ers do not consider it with any great dread from th that they effectively hold it under control by t struction of all affected trees as soon as the disea pears. In some localities, however, rosetted treee been left in hedges and waste places to propagate t ease and cause considerable destruction to adjae chards.

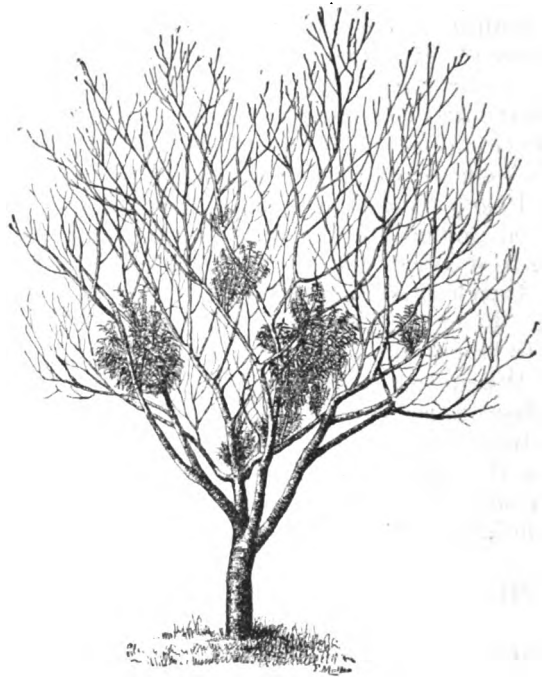


Fig. 6.—Rosette induced in a seeding by inoculation. Farmers' Bul. No. 17, U. S. Dept. Agr.)

*How to detect it*—Figure 6 well illustrates the appearance of a tree affected with rosette. This clustering together of the leaves into rosettes usually takes place in early spring and is one distinguishing character of the disease. The foliage assumes a yellowish green or orange color, or, in case of plums, particularly a beautiful red color. The leaves have a straight, stiff appearance

colled margins. One season is usually sufficient to completely kill the affected tree. In some cases, however, a tree may live two years, especially if it is not attacked in all parts at once; but when a tree is once attacked it never recovers.

*Prevention.*—The same preventive measures suggested for yellows apply also to rosette, and particularly should diseased trees be promptly dug up and burned. In rows and hedges where peaches and plums are growing should be watched and affected trees destroyed. By a series of experiments, Dr. Erwin F. Smith,\* of the U. S. Department of Agriculture, determined that it can be communicated by bud inoculation, being necessary, however, for the tissues of the bud stock to unite before inoculation is effected. Further than this its manner of spread is unknown. Dr. Smith suggests that possibly the disease may enter through the roots, but this has not yet been proved. It is certain, however, that it does spread naturally and that a few affected trees left standing in an orchard will in time cause the destruction of the entire orchard. Hence the importance of rooting up diseased trees.

#### THE WOOLLY APHIS. (*Schizoneura lanigera*.)

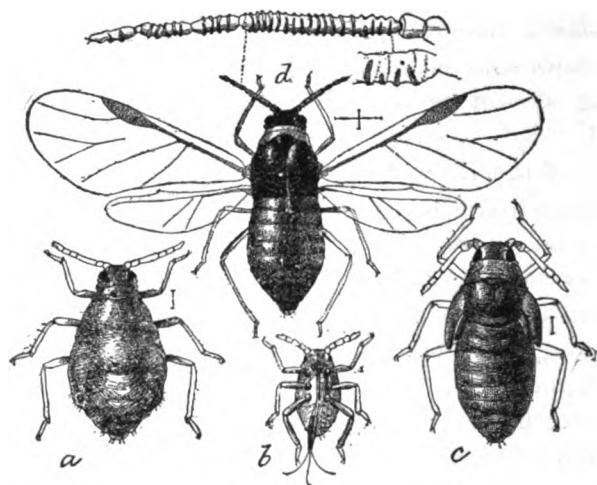
This insect is especially injurious to young apple trees, first in the nursery and then in the orchard. It is most abundant and does its principal damage on the roots of apple trees, but spreads also to the bark above ground, where it is particularly likely to appear on the young shoots which start up from the root of an injured or healthy tree. Where abundant it forms bluish-white cottony patches, not unlike some kinds of mould, which, on careful examination, are seen to consist of a crowd or mass of minute sluggish insects, their bodies covered with a cottony coating which gives the general effect described. They are usually most abundant on the roots, but sometimes appear above ground also on the bark of

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Farmers' Bulletin, No. 17, U. S. Dept. Agr., page 17.

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the trunk or branches. On the exposed parts of the they are most likely to be noticed about the collar and the forks of the principal branches, or wherever an injury to the bark has left a scar. When trees in a sery or young orchard have a sickly look—the le dull and yellowish—and are not growing well, the



**Fig. 7.**—Woolly Aphis (*Schizoneura laniger*).—*a*, Agam male; *b*, larval house; *c*, pupa; *d*, winged female with antennae enlarged above, all greatly enlarged and with waxy excretin removed (Mariatt, U. S. Dept. Agr.)

ence of this insect on their roots may be suspected though there may be no appearance of it on the above ground. If the roots of such an infested tree examined they will commonly be found distorted and formed with hard knot-like enlargements, many of them almost dead, or even in course of decomposition. These gall-like growths occur on roots of various sizes to a depth of a foot or more beneath the surface. Unless the tree is so far gone that the insects have deserted it, they will commonly be found upon these injured roots at all seasons of the year.

The apple is the only tree liable to attack by this insect, the current supposition that it may live on roots of forest trees being an error due to confusion of injury by the woolly aphis with that by the root-rot.

ves under ground at all seasons of the year it comes  
 manifest more or less generally the soil itself, although  
 may be cleared of it by a few months' thorough cul-  
 tion sufficient to destroy effectively all living apple-  
 s. Like many other plant-lice, the woolly aphid mul-  
 ies throughout the greater part of the year by the  
 h of living young from generations of wingless fe-

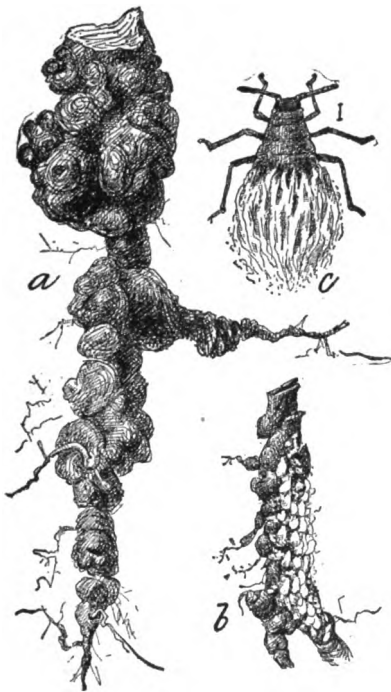


Fig. 8.—Woolly Aphid (*Schizoneura lanigera*).—a, root of young illustrating deformation; b, section of root with aphides clustered over it; c, root louse, female—a and b, natural size; c, much enlarged. (Marlatt, U. S. Dept. Agr.)

es only, but in October or November winged females  
 appear somewhat abundantly, and, flying freely, espe-  
 cially before the wind, distribute the species widely.  
 From these descend in the same autumn a generation  
 of males and females, the latter of which eventually lay  
 a single winter egg. This is commonly placed  
 within a crevice of the bark, and, hatching in spring,  
 they rise to a new colony. There may be more or less  
 migration back and forth from the groups above ground

to those on the roots at almost any time of the summer and fall.

This insect is universally distributed and extremely common, both in orchards and nurseries, becoming evidently more so to the southward. Being highly injurious to young trees, it is a difficult pest to deal with in the nursery trade. It probably cannot be wholly eradicated from an infested nursery, and, perhaps, can never be completely and permanently kept out of a new plantation. Fortunately, trees a few years old, once established, commonly suffer but little from its presence, and our preventive and remedial measures must consequently be directed to the preservation of young stock. No tree whose roots are visibly injured by woolly aphis should be allowed to go from the nursery, and none in the least infested by it should be sent out until the roots have been freed from it by insecticide application.

The simplest method of destruction of the aphis on roots is dipping for a few seconds in water kept heated to 130-150 deg. Fahr. Where heat cannot be conveniently maintained, kerosene emulsion, diluted to contain about ten per cent. of kerosene, may be substituted. In the nursery, seedlings or graftings may be protected by using tobacco dust freely in the trenches in which they are planted, or by sprinkling together dust in a shallow row along each side of the nursery row as closely to the tree, and afterwards covering loosely with earth. Infested trees should not be sent out from the nursery except after fumigation with hydrocyanic acid gas, after dipping the roots in hot water or in kerosene emulsion. Trees with aphis galls or knots should never be sold, but thrown out and burned. Trees which have been growing longest in the nursery are usually the worst infested. Culls kept from year to year, apt to be in nurseries for the multiplication of these and other destructive pests. In preserving overgrown trees in place of making a cheap sale, the nurseryman usually "saves the penny and loses the pound."

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ETIN No. 125.

JUNE, 1903.

ALABAMA.

# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## Some Diseases of Cattle.

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By C. A. CARY

and

F. G. MATTHEWS.

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## PART I.

BY C. A. CARY.

### COW POX. VARIOLA.

**COW POX** is a skin disease naturally occurring in cattle and rarely appearing in other cattle. It may be transmitted by inoculation to calves and to man. The nature of the virus has never been discovered: various kinds of bacteria have been reported as the cause; some investigators claim that it is produced by a malarial micro-parasite.

The period of incubation is said to be from three to four days. The eruption occurs usually on the teats, udder and neighboring parts; some observers report eruptions on the inside of the thighs, on the head and on the scrotum and perineum of the bull.

The teats at first become slightly swollen, sensitive and somewhat hard; in a short time appear a number of pimple-like modules, having hard or tumified bases. On the teats and udder around the base of the teats on transparent skin these modules are scarlet red or pink; on white skin they are bluish white, giving a faint cent reflection; on a dark skin the nodules have a gray color; and, if the skin is thick and tough the nodules may be a dirty yellowish gray in color. The papules or nodules are enlarged papillæ of the skin and vary in size, yet they average about one-fourth of an inch in diameter. In about two days the outer layer of the papule is raised, around the center of the enlarged pimple accumulates viscid, yellowish lymph, which is in separate sacs (multilocular vesicles); by thus raising the outer layers of the nodule its center appears depressed.

me nodules the excess of lymph raises the entire outer layer of skin over the nodule, forming one large unicellular vesicle, filled with thick, yellowish lymph (serum). The vesicles usually become mature in 8 to 10 days, and vary in size from one-fourth to three-fourths of an inch in diameter; they are usually circular on the udder and may be elliptical on the teats. When the vesicles are not broken their contents become purulent (filled with pus), the centre first becomes brown in color which soon extends to the border of the pustule. The pustule dries and a dark brown scab or crust is formed which usually drops off about the fourteenth day, leaving a pale red, white and shining, depressed scar. The vesicles or pustules on the teats are always broken by the milker and the brown scabs come off prematurely and sometimes drop into the milk to be removed from it by the strainer. Complete recovery takes place in the eruptions that appear on the udder in about 21 days; but with those on the teats successive scabs or crusts are removed, ulcers become "cracked" and raw, and healing occurs slowly, requiring in some instances thirty to forty days. During this time re-infection or infection with pus germs may take place and thus successive crops of nodules (possibly vesicles and pustules) and scabs may appear. In the case under my direct observation there were four successive crops of eruptions in four months (winter and spring) on the teats and udder of the same cow. Crusts from the third crop were mixed with dilute glycerine and calf was inoculated, by vaccination, producing an ulcer with a scab or crust without apparently passing through vesicular and pustular stages. Had I used the crusts from the first crop I am confident true cow pox would have been produced in the calf. Moreover, the calf inoculated had been getting the milk from this cow (not milking) and may have become immune before being inoculated.

Dr. Van Es, while practicing in Mobile, reported a case where a milker became infected on the hands milking cows with cow pox.

Owing to the fact that man is inoculated (vaccinated) with bovine virus (cow pox virus) to produce a permanent immunity to small pox, it is possible that many cows become inoculated by milkers who scratch their vaccinated arms and fail to disinfect their finger nails before milking the cows. Records (Crookshank and others) seem to indicate that cow pox is usually more prevalent when small pox scares are numerous, and many people are vaccinated; this relationship appears to be true so far as the imperfect records of cow pox in Alabama indicate. I have observed that children who drink raw milk sometimes have ulcers not unlike vaccination ulcers, about the mouth or face or on the hands; this may result from scratching pimples, eroded places or abrasions when the finger nails are covered with infected milk.

The fact that milkers, who become infected with cow pox, were partly or wholly immune to small pox, led Jenner to discover and apply the method of vaccinating man with cow pox virus in order to protect him from virulent small pox.

The virus of cow pox is fixed and can only be transmitted by direct inoculation. Generally the milker carries it from one cow to another and, if not immune, inoculates himself, or carries it from his vaccinated arm to a susceptible cow. One attack, or series of eruptions, produces immunity in a cow for life. Hence young cows during first period of lactation (with first calf) are the most frequently infected; yet older cows may have been not already immune. It is generally more virulent in winter than in summer.

The chief troubles resulting from cow pox are the annoyance or difficulty in milking and sometimes a decrease

ow of milk; the latter may be due to lack of removing  
l the milk; also "caked bag" or mammitis may be a  
quel to lack of removing all the milk. Moreover, there  
some danger to non-immune milkers and possibly to  
n-vaccinated children.

Treatment consists in isolating the affected cows and  
lowing the same milker to milk the diseased cows and  
others. The milker should keep his finger nails cut  
ose and smooth and thoroughly wash and disinfect his  
nds after and before milking with a 2 per cent. solution  
creolin, or corrosive sublimate 1 part and water 1,000  
rts.

The udder and teats should be washed just before  
ilking and covered with one of the above antiseptics.  
fter milking apply some of the following to the bag and  
ats: Copper sulphate 1 dram and water 1 quart. Some  
ve used the following with fairly good results:

Tannic acid .....	1 ounce;
Salicylic acid .....	4 drams;
Vaseline .....	3 ounces.

Apply just after using the copper sulphate solution.

The milk should be boiled before using, especially for  
ildren. Apparently it has no bad effects on calves not  
owed to suck.

**Varicella** or false cow pox is characterized by having  
ngle celled vesicles and by its rapid course, passing  
rough the papular, vesicular, pustular and healing  
ages in six to twelve days. The scab or crust is thinner  
d not depressed in its centre as in cow pox. The ves-  
es and pustules have the same outline as those of cow  
x, but are smaller in varicella than in cow pox.

Notice that these are variations in degree rather than  
kind; this makes it difficult to distinguish true cow  
x and false cow pox in some instances—especially in  
e early stages. In varicella there may be successive

crops of eruptions on the udder and teats extending several weeks or three or more months. Possibly later eruptions are due to infection by pus germs or mixed infection. The true cause of varicella is also unknown. Yet it is infectious and can be transmitted from the milker from one cow to another and possibly from a cow to the milker. A similar disease in men is commonly called chicken pox; so far no direct relation between the disease in cows and in man has been established. No inoculations have been made as in cow pox.

The treatment for this is the same as for cow pox.

**Furunculosis** is a disease that is also found on the teats and udder of the milch cow. It is an inflammation of a hair follicle and its subcutaneous gland, and of a certain amount of connective tissue surrounding the follicle. The cause is an infection through the follicle by one or more of the pus germs, usually the *micrococcus pyogenes* var. *aureus* or *albus*. Generally the central part of the furuncle undergoes necrosis, or degenerative changes, forming a small pus collection, which usually escapes by a break in the skin and rarely by erupting into the milk sinus or reservoir of the udder or ducts of the teat or udder.

Furuncles (small boils) appear usually about the base of the teats, but may occur anywhere on the udder or teats; some report their occurrence on the vulva and perineum.

At first the furuncle is a hard, swollen nodule, about one-half inch in diameter; in the course of a few days it becomes soft in its centre and with slight pressure the pus erupts. Another or several more may appear near the first one, and thus a series of successive furuncles may appear on the teats and udder during the greater part of the period of lactation. Sometimes the nodules are quite deeply situated and remain without erupting; these are usually about the base of the

in other parts of the udder; they may be, in some cases, tuberculous modules.

No doubt that filthy hands, dirty finger nails, open a way to infection. Pus germs are very often found on dirty finger nails and on the dirty skin of the udder; moreover, long, sharp and rough finger nails are fine instruments for inoculation.

Treatment consists in cleanliness and disinfection. Keep the finger nails smooth and closely cut, and the udder and hands thoroughly washed, chances for infection are very limited.

After infection, wash the udder with water that has been boiled and cooled; apply a 2 per cent. creolin, lysol or carbolic acid solution; or corrosive sublimate 1 part in water 1,000 parts. Be sure to wash and disinfect the udder well immediately after a furuncle erupts. Remember cleanliness of hands, finger nails and udder will prevent it.

#### INSTRUCTIONS TO THE FLOW OF MILK FROM THE TEAT.

Chronic inflammation or irritation of the lining membrane of milk duct or canal in the teat (through which passes the milk from the milk reservoir or sinus in the teat to the bucket or air at time of milking) may lead to gradual thickening of the lining membrane and consequent narrowing of the duct. The milk will then flow as a very small stream and the calf or milker may be unable to remove all of the milk, and thus "dry up" that quarter or produce clotting of the milk or inflammation of the bag ("garget" or "caked bag.") Chronic inflammation may be a result of the growth of germs in the small amount of milk left in the milk sinus of the duct, or the growth of germs in the lining membrane



of the duct. The use of a filthy or rough dilator or tube may irritate the membrane. The most common cause of infection, according to my observations, is the employment of filthy finger nails or a dirty knife to move a clot or a temporary obstruction in the duct. Thickening of the lining membrane is usually near the lower end of the duct, but in one instance I found the duct obstructed in the entire length in all four tests. According to the owner, the cow was not carefully properly "dried up."

The duct in the teat may, also, be obstructed by growth in the substance of the teat, which presses on the duct and obstructs the flow of milk. The growth may be in or on the lining membrane of duct and anywhere along its course, but most frequently at its lower end. In some cases a false membrane develops across the sinus or reservoir preventing the flow of milk into the teat; this can be determined by using the milk tube probe or small dilator.

In extremely rare instances lime-like deposits may be placed in the milk ducts and sinuses, and appear in the duct of the teat as sand-like grains or particles obstructing the flow of milk.

The most common causes of obstruction of the flow of milk in the teat are clots of milk (casein) resulting from infection of the milk by germs getting into the udder through the duct in the teat; retention of milk in the udder for a long time; and catarrhal and other forms of inflammation in the udder. Milk is a good food for germs, and various kind of bacteria will grow in it, many of which will precipitate the casein, thus forming clots in the sinus of the udder.

TREATMENT of obstructions will vary with the conditions presented. Narrowing of the duct may sometimes be relieved by using dilators (figs. 1, 2); it may be n

leave the dilator in the canal or duct for an hour just before milking. Be careful to cleanse and the dilator just before using, with boiling water and disinfectant. When dilators will not accomplish the desired result, use a small knife blade, lance or the teat slitter (fig. 5), and enlarge the duct in place of narrowing; then use the dilator or probe to remove the narrowing of the duct as the wound heals. Sometimes growths or small enlargements on the inner wall of the duct may be clipped off with very small pointed scissors or twisted off with small forceps. Sand-like deposits in the sinus may require considerable dilatation of the duct with the ordinary or small dilator (fig. 3); or the small forceps may be used to remove the sand-like particles. A false membrane in the milk sinus or reservoir may be pierced and removed with a small knife (fig. 8). Clots of casein may be removed by using a milk tube (figs. 9, 10), or by using dilators (fig. 3), and complete and frequent milking. If the udder is inflamed use antiseptic injections and applications as directed under head of garget or mastitis of the udder.

**ULCERS OR WARTS** on the bag or teats may be removed with knife or scissors when the cow is dry; cut as deep or a little deeper than the thickness of the skin. Care should be taken not to cut around or close the opening of the duct of the teat; it might leave a permanent opening or the contraction of the scar tissue close the duct. After clipping apply once or twice castor oil, 3 ounces; salicylic acid, 4 drams.

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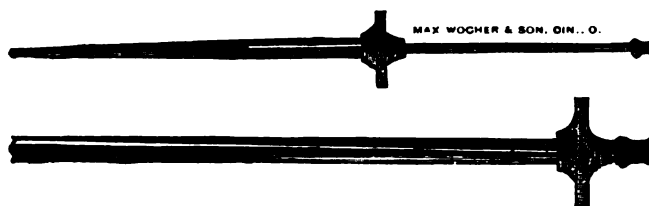


Fig. 1.—Test dilator closed and open: used in dilating a narrow or contracted milk duct.

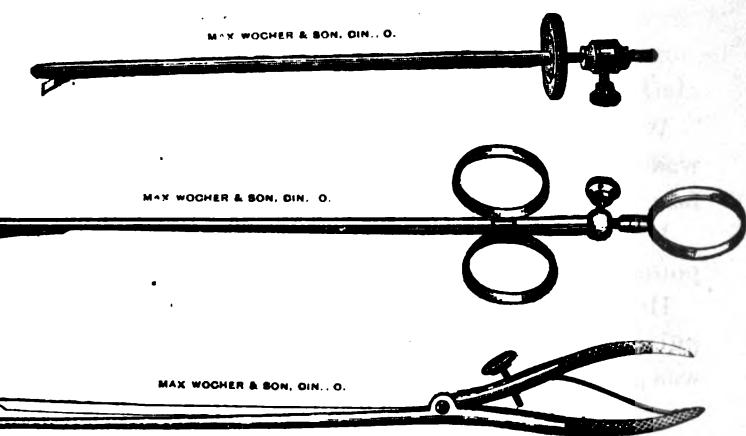


Fig. 2.—Grooved dilator for opening obstructed teats.



Fig. 3.—Spring dilator for removing membranes, clots, and sand-like particles.

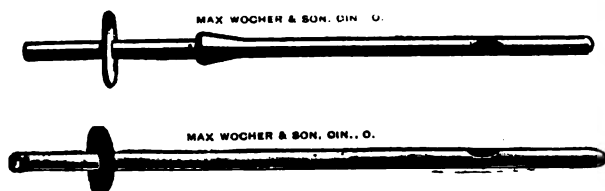




Figs. 5, 6 and 7.—Three kinds of teat slitters, any one of which may be used for enlarging narrow or contracted milk ducts.



Fig. 8.—Small tenotome knife (showing only part of handle), which may be used in enlarging a contracted milk duct or cutting opening in a false membrane across the milk sinus.



Figs. 9 and 10.—Milk tubes.

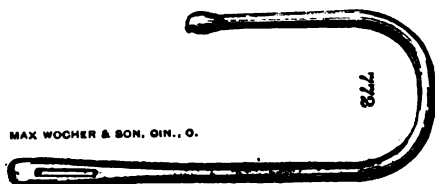


Fig. 11.—Lead probe to be inserted in the milk duct after teat cutting, and retained until healing and danger from excessive contraction of the wound is passed.

## POISONOUS PLANTS.

TESTS OF EXPERIMENTS WITH *KALMIA LATIFOLIA*

We used a 5 per cent. infusion of the leaves, w  
was prepared under the direction of E. R. Miller,  
fessor of pharmacy.

I. A scrub cow, about 5 years old, weighing  
pounds, was used.

Her temperature was 103.2 Fah., respirations 10  
pulse 34 just before the drug was given. At 3 p. m.  
was given 3 quarts of the 5 per cent. infusion.

At 4 p. m.—

Temperature .....	103.2 Fah.
Respirations .....	10.
Pulse .. . . .	37.

At 5 p. m.—

.. Temperature .. . . .	103.4
Respirations .. . . .	10.
Pulse .. . . .	36.

Pulse slightly irregular; cow showed distinct muscle  
weakness; wobbled about as if drunk; pupils slightly  
dilated; some muscles showed quivering or twitching  
movements.

At 8 p. m.—

Temperature .. . . .	102.4
Respirations .. . . .	11.
Pulse .. . . .	24.

In attempting to move, cow fell and was unable  
rise. Pulse somewhat irregular and weak; muzzle  
and mucous membrane pale and dry; pupils greatly  
dilated (amaurotic); some muscular twitchings.

At 9:30 p. m.—

Temperature .. . . .	102.
Respirations .. . . .	12.
Pulse .. . . .	36.

weak, but more regular; cow could rise, but in walk fell; pupils still greatly dilated; muzzle mucous membranes pale. Air was cool, and shivering.

morning cow was up, but weak and wabbling; longer and pupils normal in size.

Temperature . . . . . 100.4

Respirations . . . . . 12.

Pulse . . . . . 36.

bull calf, about 10 months old, was given at m. one-half pint of a 5 per cent. infusion of *Kalmia latifolia*.

At 9:30 a. m.—

Temperature . . . . . 99.2 Fah.

Respiration . . . . . 8.

Pulse . . . . . 32.

15 a. m.—

Temperature . . . . . 100.8

Respirations . . . . . 12.

Pulse . . . . . 54.

time calf was given one-half pint of linseed oil  
ums of tannic acid.

m.—

Temperature . . . . . 101.2

Respirations . . . . . 10.

Pulse . . . . . 48.

as down, unable to rise; pupils dilated; spas-  
itching of muscles; pulse weak and irregular.

ext morning calf was up ready for its breakfast.

ic acid may have temporarily prevented the  
n of the poisonous principle, but prevented the  
producing purgation.

A sorrel mare, about 9 years old, weighing about  
ds.

efore giving the drug her

Temperature was . . . . . 99.

Respirations . . . . . 12.

Pulse . . . . . 30.

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At 10 a. m. she was given 1 quart of a 5 per cent infusion of the leaves of the laurel ivy (*Kalmia latifolia*). She coughed considerably during the drenching, which indicated that some of the infusion went into the lungs and wind pipe; possibly this made the drug act quicker than usual. At once the mare began to retch, frothed at the mouth and breathe rapidly; pupils became dilated, co-ordination of muscular action lost; animal excited and struggling.

At 11 a. m.—

Temperature . . . . .	96.
Respirations . . . . .	56.
Pulse . . . . .	46.

Breathing rapid and irregular; pulse weak; membranes of nose pale and of the eye slightly congested; frequent convulsive movements of the limbs.

At noon—

Temperature . . . . .	95.
Respirations . . . . .	60.
Pulse . . . . .	46.

Breathing still very rapid; pulse weak; animal comes more quiet; pupils still greatly dilated. Muscular twitchings appear first in the face and extended over the surface muscles of the body; occasionally there are convulsive movements of the limbs; surface of body cool.

At 1 p. m.—

Temperature . . . . .	94.4
Respirations . . . . .	52.
Pulse . . . . .	46.

Animal very quiet; pupils dilated; eye dull; membranes of mouth and nose of leaden color and membranes of eyes congested; muscles continue to twitch; surface of body cool.

At this time (1 p. m.) the animal was given 1 ounce  
95 per cent. alcohol in 4 ounces of water.

At 2 p. m.—

Temperature . . . . .	95.
Respirations . . . . .	30.
Pulse . . . . .	48.

Animal relatively more quiet; pupils continue to de-  
crease in size; the mucous membranes of nose and mouth  
some slightly scarlet in color; muscles still twitch.  
Give animal another ounce of alcohol.

At 3 p. m.—

Temperature . . . . .	98.2
Respirations . . . . .	28.
Pulse . . . . .	50.

Pupils normal in size; muscles twitching less and more  
relaxed; mucous membranes of mouth and nose about  
normal in color, and surface of body warm.

Given another dose of alcohol with small quantity of  
oil in it.

At 4 p. m.—

Temperature . . . . .	99.6
Respirations . . . . .	28.
Pulse . . . . .	60.

Animal much better; given another dose of alcohol.

At 5 p. m.—

Temperature . . . . .	100.4
Respirations . . . . .	26.
Pulse . . . . .	63.

At 5:30 p. m. animal was able to rise with a little help;  
muscles still twitching some; animal some weak, and  
trembling, but able to walk about 200 yards to a box  
all.

Next morning her appetite was good, and she showed  
no signs of having had a hard drive, but 24 hours later  
had entirely recovered.

From the three tests and from numerous cases where  
animals have eaten the leaves of *Kalmia latifolia* it is



very evident that the leaves contain an active poison. Several chemists and pharmacists have found indications of an alkaloid, but a sufficient quantity has never been isolated to test its poisonous effects on cattle or horses or sheep. Sheep and cattle eat the leaves of the shrub in winter or spring when pasturage is short, and when the animals are hungry for green feed. No doubt they will eat it at any season where pasturage and feed are scarce and the opportunity is given to them. This flowering shrub is very common in nearly all parts of Alabama, possibly more common in hilly regions and along mountain creeks. The shrub flowers in the spring, and is evergreen, having green leaves all the year around. It is commonly called the laurel or laurel ivy.

**TREATMENT.**—Alcohol acts as physiological or chemical antidote. Whiskey, brandy or alcohol (diluted) may be given every two hours in 1 to 3 fluid ounces doses. Also, a purgative of 1 to 2 pounds of Epsom salt dissolved in 1 quart of water or 1 to 2 pints of flaxseed or linseed oil. Do not repeat the purgative under 24 hours. One to three fluid drams of creolin or lysol may be added to the purgative in order to check fermentation while the bowels are inactive.

The shrub should be cut down, or, better still, grub it up and burn it, and thus prevent cattle and sheep from getting it; this is possible and practicable in all localities.

**The Red Buckeye** (*Aesculus Pavia*, L.) is another shrub or small tree whose leaves are poisonous. The clinical symptoms are very like those of poisoning from *Kalmia latifolia*. The treatment is about the same; at first a good purgative is given and followed with a stimulant, especially during the period of depression. In pastures grub it up and burn all the Red Buckeye bushes and small trees.

Batchelor (*American Journal Pharmacy*, 1873, 145), found in the seed of the red buckeye, a poison

coside ( $2\frac{1}{2}$  per cent. in seed). It acted on the cat somewhat like strychnine. The leaves are said to be most poisonous just before, or about, the time of flowering. Cattle and sheep usually become poisoned by eating the leaves, and occasionally by eating the seed.

#### POISONOUS PLANTS CONTAINING HYDROCYANIC ACID.

Prof. E. R. Miller, Pharmacist at the Alabama Polytechnic Institute, found that the leaves, bark and root of the *Prunus Carolinensis* (mock orange) contained hydrocyanic acid.

*Prunus serotina* (wild cherry),  
*Prunus Virginiana* (choke cherry, and  
*Prunus Persica* (peach), all contain hydrocyanic acid at times in their leaves. They contain amygdalin, glucoside and emulsin, a ferment or enzyme. In the presence of water the emulsin acts on the amygdalin and hydrocyanic acid, glucose and a volatile oil are formed. The action of the ferment is destroyed by boiling.

The leaves of these plants are said to be more poisonous or contain more hydrocyanic acid when kept in wilted condition, without completely drying out, for several hours. In the rumen or first stomach of the ox or the sheep where there is little or no acid and where the food macerates in a watery secretion, neutral or slightly alkaline, would be an admirable place for emulsin to act on amygdalin and produce hydrocyanic acid.

**Sorghum** (*sorghum vulgare*), according to Peters, Wade and Avery, of the Nebraska Station, contains hydrocyanic acid when it is stunted or checked in growth by dry seasons and also *young, frosted* or second growth sorghum may contain it. No doubt, many of the reported cases of sorghum poisoning are due to acute indigestion (bloat) and not to hydrocyanic acid. As

the conditions now stand no one can tell when sorghum is poisonous without a feeding test or a chemical analysis. Cases have been reported of poisoning from eating kaffir corn and pasturing Johnson grass, but the presence of hydrocyanic acid has not been discovered in Johnson grass.

In August, 1902, Mr. J. P. Logan, of Selma, reported the following facts to me:

Nine head of cattle were turned into a Johnson pasture for the first time; it was about four o'clock in the evening; the cattle became sick in ten minutes after eating the grass; gave 8 of them linseed oil and 2 died that night and 6 recovered; one not treated died in three hours.

The Johnson grass from this field was tested for hydrocyanic acid, and none was found in it. The recoveries, by the treatment given, seems to indicate that the cattle had acute indigestion.

In July, 1899, during a very dry time, Mr. Hazen, a dairyman of Birmingham, Ala., turned 20 cows into a sorghum field that had been injured by army worms and by drouth; in twenty minutes, he says, 18 were dead; 2 were saved by treatment. The 18 cattle were within 50 feet of the gate through which they passed into the sorghum field.

Hydrocyanic acid is a very unstable compound and this accounts for the fact that many plants that at times contain it do so only under certain conditions and for a short time. Any condition that checks or stunts the growth of sorghum should lead one to regard it as a dangerous feed until proven otherwise.

**SYMPTOMS OF HYDROCYANIC ACID POISONING** are the same regardless of the source of the drug. Of course the larger the dose the more rapid and fatal its action. It can be absorbed from the unbroken skin when in a watery solution: it is readily absorbed from the al-

ary canal acting as a sedative and anaesthetic on the mucous membranes. Small doses depress the heart by stimulating the vagus centre in the medulla; large doses stimulate the vagus centre and depress the heart by acting directly on it, paralyzing it almost instantly. The vaso-motor centre is paralyzed and blood pressure falls very low.

The respiratory centre is paralyzed usually before the cardiac or vaso-motor centres. Toxic doses produce insensibility and coma; in animals convulsions may occur. Large dose paralyze the peripheral nerves and the voluntary muscles. Shortly before death the spinal cord is paralyzed. The pupils are dilated. In brief, hydrocyanic acid quickly depresses respirations, the pulse or heart action and blood pressure, and paralyzes the muscles and nerves of the limbs; depresses the action of the alimentary canal and dilates the pupil. In many cases these actions are so quick that there is no time to give antidotes or treatment. Drowsiness, running at eyes, twitching of the muscles, staggering gait, inability to stand, involuntary passing of urine and feces, dilated pupils, frothing at the mouth—are given by Peters as the prominent symptoms.

In cases where time is given for TREATMENT give a stimulant of 1 to 4 ounces of brandy, whiskey, or diluted alcohol or ether. When the animal can not swallow, give the drug per rectum or hypodermically. Stimulate respiration by holding dilute ammonia to the nose and by giving one-half grain doses of strychnine hypodermically once every three or four hours.

As soon as the animal can swallow give cow or ox 1 quart of melted lard (not too hot), or 1 quart or raw linseed oil and 1 pint of syrup diluted with 1 pint of water. If cow begins to swell from the formation of gas by fermentation in the stomach and intestines, give 1 ounce of creolin in 1 quart of water. Do not repeat purgatives under twenty-four hours. Sheep and calves

take doses of medicine about one-fourth as large as large and grown cattle.

In all cases where possible prevent the animal from eating the leaves of the mock orange, the cherry, the peach—especially wilted leaves on recently cut or pruned branches. In case of sorghum, always test the stunted sorghum by cutting and feeding a little to the turning cattle into the field to graze on it. In case of it is best and safest to begin to feed it gradually, by the soiling method, and after the cattle have been brought up to full feed in that way, they may be turned into the field for a short time each day until they become accustomed to it. Very few cases of accidental poisoning have been produced by cutting sorghum and feeding it to cattle; yet such instances have occurred both with sorghum and kaffir corn.

*Phytolacca decandra* has been reported as poisonous for cattle. G. R. White, in the Journal Comp. Med. and Vet. Arch., 1902, p. 439, reports that 5 out of a herd of 13 were affected with hæmorrhagic enteritis accompanied with dysentery. White attributed the enteritis to the eating of the plant.

From an unpublished article of Prof. E. R. Miller of the Alabama Polytechnic Institute, at Auburn, are obtained the following facts:

Three different times Prof. Miller became sick from the grinding of the roots of *phytolacca*. The illness was very like the preliminary symptoms of influenza; alternate periods of chilling and high fever; intense headache; insomnia and restlessness; some irritation of nose and throat; lasting for about 24 hours. Students were very similarly affected; also a student ground the roots of *phytolacca* and was similarly troubled. One student was not affected; another had i-

of the nose and throat and eyes, lasting about 24  
rs.

The professor became affected three different times;  
students and a negro once and one student was appar-  
ly unsusceptible. The following was reported to  
f. Miller:

A boy applied a decoction all over his body for the  
, it produced vesication, and the skin peeled off  
from a blister. It is reported that many people eat  
ng poke root as "greens;" possibly the cooking pro-  
es some change that renders the poison inert.

It is also suggested that the young plant may not have  
contain the toxic principle; as a rule, most plants  
tain the greatest amount of their active principles  
before or at the time of blossoming.

The seed or fruit of *phytolacca* are said to contain  
*phytolaccin*, *phytolaccic acid*, sugar and gum; the root  
of *phytolacca* a resin, probably a glucoside and a vola-  
acid. Prof. Miller and his students have obtained  
ng indications of several alkaloids.

Having never treated a case of *phytolacca* poisoning,  
can only suggest that small oleaginous purgatives be  
en and the animal be fed soft feed in small quanti-  
. Raw linseed oil one-half pint and creolin 1 to 2  
ms might be given once or twice per day. If the  
mal is in pain give 1 to 3 drams of fluid extract of  
adonna or 4 drams of tincture of opium two or  
ee times per day.

#### DYSENTERY IN YOUNG ANIMALS.

Young calves, lambs or colts may have an infectious  
n of dysentery that begins usually during the first  
days, or not later than two weeks, after birth; in  
e instances infection may occur in calves several  
ks old. The cause of the disease, according to  
ard, is a short, stumpy, bacillus with rounded ends;  
quently found arranged in parrallel lines, like a

comb, with short, close teeth; sometimes they are in linear series, having very short joints, becoming thin until last segment, which is longer and club-shaped. Some are swollen in the centre and drawn into threads at extremities; others are ovoid like coccobacilli. From Nocard's description the bacillus seems to take a variety of forms; it is found in pus and in free intercellular masses. It is an obligative aerobe; stained always by Gram's method; grows in or on all media at a temperature above 86° F. (best at 95° F. to 100.4° F.). It grows best on coagulated blood serum where in 3 to 39 hours appear a number of colonies with a shiny surface, slightly raised in the centre, and appearing to send a number of roots into the medium; these colonies are white on serum from the horse, bright yellow on serum from the ox, and gray on coagulated blood.

Nocard, Lasage and Delmer believe that the principal, if not the only, method of infection is by way of the umbilical (navel) cord. Infection occurs during labour or immediately following birth while the cord is still attached. Possibly it occurs in the vagina or vulva, or most likely after the cord is torn or broken, and the young is in contact with the ground. Nocard attempted to infect calves by the alimentary canal and by the respiratory passages, but failed. But he succeeded by subcutaneous inoculation.

The experiments of Nocard, Lasage and Delmer were confined to calves in Ireland and on the continent of Europe; and their tests may not be conclusive, yet the evidence points very strongly toward navel infection.

Law, Friedberger and Frohner, de Bruin, Mouton, Deikerhoff, and others believe the disease is infectious. Many attending or predisposing causes are given, some of which are aids to transmission or infection. The following are given by various authorities as causes, predisposing, of infectious dysentery and of ordinary diarrhoea or dysentery:

The young or new-born offspring failing to get

ilk (colostrum) which is laxative in its action consequently required to remove the meconium (feces) from the alimentary canal of the young. But if the young animal is liable to have indigestion, constipation or diarrhoea: any one of these conditions might favor infection with the germ of dysentery. Causes: giving bad milk; sudden changes from whole milk to skim milk, or from skim milk to whole milk, or sweet to sour; putting a young calf on a cow far advanced in the period of lactation (milk contains too many solids); adding too much meal to milk or giving much dry meal or corn to young calves when the digestive glands are insufficiently developed to digest rich food; giving cow's milk to the foal without dilution or modification; filthy buckets or udders; damp, filthy, unclean stalls, barns and pens; bad water from infected wells, tanks, troughs or vessels; feeding green grasses; mouldy, decaying, irritating vegetable grains or hays; too much cotton seed or cotton meal; allowing colt or calf to suck when dam has been over-heated by violent exercise; feeding young calf only once every twelve hours; feeding too much (over-feeding); great irregularity in feeding, allowing colt to get very hungry and then rapidly devouring full feed.

**Symptoms.**—Some cases begin with constipation; others with soft, soon becoming watery, bowel discharges, which may be white like undigested milk, or yellow or yellow in color. At times the calf or colt is restless, with more or less straining to pass feces; appetite (sucking) is lost; abdomen may become distended or swollen and tender or tucked up (contracted); feces becomes frothy, bad smelling and sometimes streaked with blood; calf may bellow and tremble; the calf, colt or lamb may become dull, stupid, emaciated and die in one to three days, or may survive one or two weeks and die or make a slow recovery.



Some cases have pneumonia, inflammation of the artulations, peritonitis, laminitis, hepatitis (inflammation of the liver), or ophthalmia (inflammation of the eye). This disease is very frequently found in herds where infectious abortion or tuberculosis exists.

About 80 per cent. of the cases in foals are fatal to 90 per cent. in calves and 66 per cent. in lambs.

**POST MORTEM CONDITIONS**—Here and there may appear erosions or desquamations and red or congested areas on the mucous membrane of the intestines, and sometimes in the stomach. Catarrhal exudate or pseudo-membranous patches may occur on the mucous membrane of the intestines. Peyer's patches may be infiltrated and prominent; sub-mucous infiltrated, softened, and marked by small red spots (hæmorrhagic spots). Sometimes hæmorrhages may be found in the small or large intestine or in the stomach. In calves and lambs the desquamation of epithelium is most marked near the pyloric end of the fourth stomach. The contents of the intestines may be yellowish, white, gray, red, mucous-purulent and very foetid. The intestinal lymph glands are usually enlarged.

Some cases show inflammatory changes in the lungs, liver, peritoneum, kidneys, spleen, heart, articulations and eyes.

**TREATMENT.**—Prevention is the only means of successfully combatting this very fatal disease. Cleanliness and disinfections will usually keep it from a place or herd. The stalls, pens, barns, buckets, water feed, milk, cows and calves must be kept clean. Regular feed, with proper quantity and quality, avoiding any or all sudden or radical changes in the extremities of too little and too much feed, will tend to maintain healthy calves, colts and lambs.

It is always safer and better to milk a cow than to far along in the period of lactation and dilute the milk.

h water that has been boiled and cooled and feed it  
 he calf than to turn a young calf to such a cow. Do  
 force meal, corn or other grain upon the young calf  
 ore its digestive apparatus is sufficiently developed  
 digest them. At least wait one or two weeks and  
 n begin the use of such feeds very gradually. Never  
 mit the calf to eat mouldy, decayed or rotten feed  
 ay or vegetables; keep it in well ventilated, clean,  
 stall or pen and give it freedom in a clean, grassy  
 ture all the time that weather will permit.

ocard recommends the following:

White scours is generally the consequence of an  
 bilical (navel) infection which takes place at the  
 e of parturition. Farmers may prevent the disease  
 conforming strictly to the following instructions:

. Cows that are at the point of calving should be  
 vided with dry and clean litter until after the act  
 parturition.

. As soon as the premonitory signs of parturition  
 observed the vulva, anus, and perineum ought to be  
 shed with a warm solution of lysol, of a strength of  
 grammes to a liter of water (2 per cent. solution).  
 the same time a large quantity of this solution may  
 used to syringe out the vagina.

. As far as possible the calf ought to be received  
 o a clean cloth, or at least on a thick layer of fresh  
 er, which has not been soiled by urine or excrement.

. Immediately after birth the cord should be tied  
 h a ligature (strong string) that has been soaked  
 lysol. (The tie is made 2 to 3 inches below the ab-  
 domen and the cord cut off one-half inch below the  
 ture.)

. Mop or cover the umbilicus and remainder of the  
 l with the following solution:

Rain water . . . . .	1 quart.
Iodine . . . . .	30 grains.
Potassium iodine . . . . .	1 dram.

6. The disinfection of the umbilicus and cord should be completed by applying the following:

Methyl alcohol ..... 1 quart.  
Iodine ..... 30 grains.

7. When the alcohol has evaporated the operation will be completed by dressing the cord and umbilicus with a thick layer of iodised collodion (1 per cent. iodine). As soon as the collodion has dried the calf may be left with its mother."

In one outbreak of infectious dysentery in calves we have had good results by employing the following powder:

Tannic acid ..... 3 ounces.  
Boric acid ..... 3 ounces.  
Iodoform ..... 4 drams.  
Salicylic acid ..... 4 drams.

Mix and apply to the ligated cord and umbilicus (navel) immediately after birth and two or three times per day during the first three days. This thoroughly disinfects and also dries up the cord very quickly. It can be applied with a dust blower or sifter.

If calves are allowed to suckle a cow, it is always best to wash the udder once or twice daily with a 1 or 2 per cent. solution of creolin or lysol. Just before birth it is wise to wash the vulva, anus, perineum and tail of the cow with one of the above disinfectants.

Barns, lots and pens must be thoroughly cleaned and disinfected. Change calves and cows from one clean and disinfected place to another and keep well and entirely isolated from sick ones. Use plenty of whitewash, carbolic acid, creolin, lysol and other disinfectants on walls, floors, etc. Above all wash and scrub often the walls and stalls.

CURATIVE TREATMENT is not very promising; hence a great number of remedies herein suggested.

It is usually best to begin the treatment with a cathartic in order to remove the fermenting and irritating materials in the alimentary canal.

For the calf or colt give 1 to 2 ounces (2 to 4 table-  
 spoonful) of castor oil; the lamb can be given one-fourth  
 as much. Or, rubarb may be given in 30 to 60 grain  
 doses to the calf or colt and 7 to 15 grains to the lamb.  
 Calomel 6 grains for colt or calf and 1 grain for  
 lamb.

Tincture of opium is sometimes given with, or fol-  
 lowing, the purgative.

Law recommends the following:

Tincture of cinnamon.....	2 fluid ounces.
Chalk .....	1 ounce.
Gum arabic .....	4 drams.

Mix and give to calf or colt 1 tablespoonful 2 or 3  
 times per day.

Cadac uses:

Subnitrate of bismuth ....	5 grains.
Salicylic acid .....	5 grains.
Naphtol .....	20 grains.
Syrup .....	5 ounces.
Distilled water .....	4 ounces.

Mix and give to calf or colt 1 to 2 tablespoonsful  
 3 or 4 times each time it is fed.

Another authority advises the following:

Coal tar .....	5 ounces.
Boiling water ..	6 quarts.

Let cool and give one-half pint every half hour. This  
 is very useful in cases where liver is involved, (indica-  
 ted by yellow mucous membranes).

Lime water is sometimes useful: Give on to four  
 tablespoonful after calf has taken its milk. It is well  
 to boil the milk and allow it to cool without putting  
 lime water into it.

Some give a one or two per cent. solution of creolin;  
 1 to 2 ounces for calf or colt once or twice a day.

If the calf, colt or lamb is very weak, it may require  
 a stimulant; such as coffee or a teaspoonful (calf or  
 colt) of turpentine with egg or milk, or tincture of cap-  
 sicum, a teaspoonful.

Wine of ipicac is said to be very valuable in the forms of dysentery in man. It may be given to calves and colts in 1 tablespoonful doses; 10 drops to the lambs.

### ACUTE INDIGESTION IN CATTLE.

This is sometimes called "hoven" or "bloat." In the first stomach or paunch, there may be undigested, fermenting food, resulting in the formation of gases (carbon dioxide, hydrogen sulphide, etc.) and possibly acids or toxic alkaloids or glucosides.

The causes are not always apparent, but generally is due to over feeding or sudden change from dry to green succulent peavines, potato vines, corn, rye, clover, oats, potatoes or turnips which undergo fermentation in the paunch. When a cow or an ox is put down for some time, as in milk fever, lung fever or fever, the digestive organs may be checked in action and partially paralyzed; then fermentation may occur.

**SYMPTOMS.**—If gas is formed the abdomen becomes distended and resonant; (left flank larger than right,) respirations are rapid and shallow; temperature about normal; animal may grunt or moan.

In some cases (Dieckerhoff) the greatest swelling and distention of the abdomen may appear in 15 to 20 minutes after eating clover (especially when the clover is in a partially withered or wilted condition on a dry day).

In some cases of indigestion there is no appreciable quantity of gas formed and consequently little or no distention of the abdomen and flanks; the appetite may be partially or completely suspended; little or no rumination (chewing and regurgitating of the cuds), the paunch or first stomach is inactive or paralyzed; bowels normal in acting during the first day, constipated or inactive thereafter, except in few instances where the bowels may be very loose and active; pulse may be acc-

temperature normal; and in the cow the flow of milk is greatly decreased. The animal may die in 1 to 4 days, or may recover in from 2 to 8 days. When toxic albumens or glucosides are rapidly forming death occurs in a comparatively short time.

Treatment may be preventative or curative. Avoid feeding of concentrates; such as corn, cotton-seed cake, wheat etc., and decayed, moldy, rotten feed. It is most difficult to prevent cattle from getting into a green feed when they accidentally get into the alfalfa, clover, pea patch or clover. Prevention means close care and watchfulness. Change from dry to milk gradually. Curative remedies are directed at removing the undigested food and preventing fermentation and death while removing these materials from the alimentary canal. If the animal can swallow, give 2 lbs. Epsom salts and 10 to 20 drops of croton oil in 1 quart of water; do not repeat this under 12 to 24 hours. Follow or precede this with 1 tablespoonful of creolin in 1 quart of water. If you have nothing else, and the animal continues to bloat or swell, repeat the creolin solution every two hours until the swelling ceases. If you have no creolin, dissolve as much as you can in two quarts of warm water and give 1 quart of salt water every 3 or 4 hours. If you give Epsom salts give 1 to 2 pints of raw linseed oil, or cotton seed oil, or melted (not hot) lard. Do not repeat the dose of Epsom salts or oil for 12 to 24 hours.

If the animal is greatly swollen and about to die, and if the purgatives and antiseptics can act, then you may attempt to tap the rumen with a trocar and canula or a needle. This should be done on the left side some where between the hip point (haunch) and the last rib. Rub the left flank with soap and water and weak creolin solution; cut an opening through skin, about

one-half inch long; now push the trocar and canula into the paunch (3 to 4 inches deep), pull out the trocar and let the gas escape through the canula for one or two hours; when you desire to remove the canula and trocar insert the trocar into it and remove both together. This prevents infection of the wound. In case you have no trocar get a long quill or better a joint of swamp iron about the size of a lead pencil or pipe stem, boil it in water, (at least scald it), make a sharp bevelled edge on one end, and push the sharp end into the paunch through the opening made in the skin as directed above. After removing the trocar and canula or cane wash the place with weak creolin solution to disinfect the place. Give purgatives and antiseptics internally if not already given.

Feed carefully for the next few days, always give salt every day; granulated salt is better than rock salt.

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## PART II.

BY G. F. MATTHEWS.

### ABORTION.

Commonly known as miscarriage or losing, slipping or slinking the calf, colt, lamb, whichever the case may be.

Abortion may be defined as delivering (parturition) before the end of the regular period of pregnancy (gestation) or before the young has fully completed fetal life whether the little creature be dead or alive. Foetal live refers to life before birth, the young at this time being a foetus. The average period of pregnancy in farm animals is for mare and jennie, 11 months and 15 days; cow 9 months and 15 days; sheep and goat 5 months; sow 4 months. If an animal delivers 10 days before time the deviation is unimportant since

of pregnancy may vary a few days with different animals and under different circumstances.

tion, from an economic standpoint, takes rank former animals as follows: Cow, Mare, Sheep, The cow is the most liable while the sow is subject to the mishap.

viability or whether the foetus is capable of living her question. Usually it is dead. A dead foetus delivered at any time during pregnancy, but abortion occurs in the first two-thirds of pregnancy foetus is always dead. In the last third a live is frequently born.

later the stage the more likely is the little creature to live. Many die immediately, and others are weak or prove to be absolutely worthless, and in rare instances one becomes sufficiently vigorous to develop into a viable animal.

Idea of the number of living calves delivered during the last months of pregnancy and the value may be had from the record reported by Nelson at the New Jersey Experiment Station. Twelve abortions reported. Four births occurred between the 6th and 7th months; four between the 7th and 8th months; four between the 8th and 9th months. Three of the calves were dead: 1 died; 6 were killed and 2 were kept. Thus only a small percentage were of sufficient value to be kept, and it is a question if it ever pays in the long run to raise any of them.

Abortion may be either non-infectious or infectious. When occurring in the latter form it assumes an enzootic or epizootic type and it is of greatest importance to recognize this form in order to prevent the spread of the disease.

#### *Non-infectious abortion.*

Non-infectious abortion results from some known cause, such as accident, irregular feeding, improper feed, etc.,

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or happens only as a casual affair not preceded or followed by miscarriage in the same individual or other members of the herd. Not only should the home be excluded as a source of the disease, but the milk should be free from any relationship whatever with a similar accident among cows which the attending veterinarian may have served.

**Causes:** The causes of non-infectious abortion are numerous to discuss in detail. Frequently it is traced to the poor condition of the pregnant animal. This may result from insufficient or improper food, irregular feeding. The foetus dies for the want of nourishment, and is expelled as a consequence. Chronic wasting diseases may have a like effect by deranging gestation impairing assimilation and impoverishing the blood.

According to some authors an extremely fat condition predisposes an animal to abortion. This is said to occur most frequently in old cows of improved beef breeds suffering with fatty degeneration of the heart, the circulation being weak and irregular and insufficient to supply the foetus.

Drinking ice-cold water and feeding upon pastures covered by frost, or eating herbage which has been injured by frost, have caused abortion. One writer reports an instance where one-fifth of the pregnant ewes in a flock of sheep aborted immediately after drinking from a hole made through ice.

Overloading the paunch (rumen) with succulent foods, like green sorghum, clover and cow-peas, especially when covered by dew; apples, sweet potatoes or tubers, etc., and gorging the animal with stimulating foods like corn, wheat, peas, beans, cotton-seed and cotton-seed meal are exciting causes.

Foods improperly harvested and improperly cured, musty, molded and partially decayed foods may

p fermentation in the paunch, which compress the  
omb and kill or displace the fœtus.

Acute diseases, manifested by colicky pains or circulatory disturbances, may be followed by abortion. Diseases of the rectum and urinary organs, as diarrhoea and inflammation of the kidneys, bladder, etc., are predisposing causes. Parasites, like worms in the intestines, liver or lungs, and lice, are accessory causes.

Medicines injudiciously administered to ailing animals are as liable to cause abortion as the affliction. Large doses of purgatives are to be avoided, also another class of drugs known as ecbolics, rye-smut, corn-smut; cotton-root bark; cotton-seed, and cotton-seed meal, probably possess to a slight extent the active principles of cotton-root bark. Evil effects from this source have been overestimated. Grain smuts, seeds, leaves, etc., containing medicinal principles, must be consumed in enormous quantities usually to cause deleterious effects upon healthy organs. Taking for example, the smut of rye (ergot), which is the most potent of the class; it is said to require 10 pounds of the select drug to produce acute poisoning in a 750-pound cow. Such enormous quantities are not likely to be consumed at one time. The chief danger is in pasturing cattle continually on pastures where smut is abundant. A moderate quantity is consumed each day, without bad effects at first, but after a few days the active medicinal principles in the smut will have accumulated to such an extent as to cause chronic poisoning (ergotism), and abortion. Chronic poisoning from rye smut is rare, and it is questionable if corn-smut ever has that effect. Drugs, like spanish fly, which irritate the urinary organs, and purgatives which stimulate the involuntary muscles of the rectum to excessive action should be given to pregnant animals with caution, if at all.

Sudden fright, thunder storms, chasing by dogs, and

the smell of blood, or the discharge from an abortive animal, may cause abortion in sensitive, highly-bred Jerseys.

Miscarriage may follow sudden changes in the weather, especially if the victims are poorly nourished.

Violence in any form is a fruitful cause of abortion. Mares which "balk" or refuse to pull and cows which "sulk" or refuse to travel about from the unmerciful beatings received.

Jars and jolts in railway cars, and shipping long distances may cause the trouble.

Mounting other cows or being mounted by other cows or the bull; falling into ditches or having the hind legs slip unexpectedly into gutters behind the cow; jumping over fences; crowding through door ways; and so on, may definitely may result in abortion.

While it stands to reason that slight injury is less likely than severe violence to result in abortion, the result cannot be judged by the extent of the violence, for at one time an animal will carry her foetus successfully through a violent accident, and at another time abort after sustaining the most insignificant injury.

In one case a calf which was born alive, but required the assistance of a surgeon for delivery, and died as a consequence of the manipulation, was found to have the hind leg bent at right angle just above the hock. When the flesh was boiled off, the bone showed evidence of having been broken, union being complete with the exception of a small spicule of bone projecting from the part where the tissue had separated most. The owner had not seen any accident, but remembered a break in a rail fence, made, probably, by this cow, about a month prior to delivery. At any rate, it shows that a pregnant animal may suffer violence little short of death of the foetus and not abort.

On the other hand, the most insignificant accident may be responsible for abortion. A mare had one hind

to slip unexpectedly through the board crossing over an open ditch. The foot sank but a few inches, not more than 12 or 15, as the drain was not deep. However, the mare aborted and the owner could ascribe the mishap to no other cause.

A dead foetus is seldom retained, though in exceptional cases it may remain in the womb until quite putrid. The foetus may be killed as a result of external violence; die from displacement or twist of the womb; excessive collection of fluids in the foetal membranes; deformation; diminished circulation or impaired nutrition, whether affecting it directly or indirectly through condition of the mother.

The symptoms, cause and after treatment does not differ materially from that of infectious abortion. The principal requisite in treatment is to remove the cause. Directions for treating retention of the after-birth (placenta) always a serious consequence in these cases and prolapsus of the uterus, will be given in the treatment of infectious abortion.

#### INFECTIOUS ABORTION.

By infectious abortion is meant that form of abortion which has a tendency to recur in the same subject or is associated with—proceeds or follows—abortion in other animals. Single cases caused by infection cannot be distinguished from the non-infectious sort.

Prevalence in Alabama.—

Infectious abortion is said to be widely distributed over the civilized world. In Alabama it is confined largely to the herds in the vicinity of the larger towns and cities.

The hardy range or "scrub" cattle of the State, like wild cattle, are remarkably free from the disease.

At present marked interest is being manifested in breeding beef cattle. This interest is increasing.

Several herds have been started in various parts of

the State, and there is a growing desire to breed up native cattle. Improved stock have been shipped from the North, Northwest and West for this purpose.

One purpose of this article is to acquaint present and prospective breeders with the nature of the disease and warn them of the dangers of introducing a disease which would prove detrimental to the business. The first requisite in breeding beef cattle is to secure the greatest number of vigorous calves. Infectious abortion strikes with certain fatality at this part of the industry. The only way to avoid incurring the dangers of an infectious disease is to prevent its introduction.

Dairymen, especially those who keep cows for milk and milk products, often fail to realize the economic importance of the disease. Such dairymen do not value their calves. Indeed, the loss of the calf in this case amounts to nothing, and the matter might be dismissed if there were not other sources of loss. There is another reason why some persons are led to believe abortion is no disadvantage. Occasionally a cow having missed one calf period, aborts before the next and begins to give a normal flow of milk.

This is well illustrated by the report of four cows which came under the observation of W. W. Cook of the Montana Experiment Station. So also is the pecuniary loss illustrated.

One cow aborting two months before the time to calve a calf, yielded 200 gallons of milk, or the equivalent of 70 pounds of butter less than she had yielded the previous year after normal birth.

Loss from the second cow was 240 gallons of milk or a butter equivalent of 60 pounds and from the third cow 240 gallons of milk or 75 pounds of butter. The fourth cow which had been milking 16 months and had carried a fetus 7 months, miscarried without apparent disadvantage. In fact, this cow the previous year, 5 months after delivery, gave 15 pounds of milk per day and 21 pounds per day 5 months after aborting.

*Causes.*—Infectious abortion, as the name implies, caused by an infectious agency, or contagion. Authors do not agree as to the nature of the germ or as to how the germ brings about the act of abortion. American and European investigators do not agree and European investigators do not agree among themselves as to the identity of the microbe. Some claiming a micrococcus and others a bacterium as the effective agent. American investigators have found true bacilli belonging to the coli group in the membranes and womb of aborting animals. Aside from this there are other reasons for separating the disease in America and that in Europe into two different types. The disease in Europe is more virulent; a longer time is required to establish immunity; and there seems to be a difference in the manner in which abortion is brought about, viz.: in some cases the germ invades the foetus, inhabiting the alimentary canal, in one instance, and the meninges of the brain and spinal cord in another; again the infection is insinuated between the cotyledons on the maternal and foetal membranes, and modifies the foetal food supply, causing in either case the death of the foetus, which, for that reason, subsequently expelled. In America no writer has ever reported the presence of the germ in the foetus, and the number of living foetuses born indicate that death from modified food supply is not a prerequisite.

In view of these facts the writer will confine the discussions to what he may term the *American form of Infectious Abortion*.

It is singularly significant that all American investigators have found closely related, if not identical bacilli associated with the disease.

Chester, of the Delaware Experiment Station, isolated from the placenta of an aborted calf, a bacillus closely resembling the bacillus coli; which produced slight tarrh of mucous membranes when injected into the vagina of a cow. Law and Moore, of New York, found

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in a number of aborting cows, widely distributed in the State, a bacillus almost, if not identical, with *Bacillus coli* in form and culture characteristics. This, it is supposed, caused more or less catarrh when injecting into the vagina of healthy cows. Law further states that this particular microbe could not be found in the vaginal discharge of cows in herds free from infectious abortion.

Kilborne and Th. Smith studied a bacillus of the same group, infesting the vagina of aborting mares. Supposing catarrh resulted from vaginal injections in mares and cows.

At this Station we have isolated from vaginal discharge and from ulcers on the vaginal mucous membrane of two heifers which have never been bred, but which are supposed to be infected with the abortion microbe, a bacillus which is indistinguishable from the *Bacillus coli* morphologically and closely resembles Oter's bacillus in culture characteristics. Inoculation of the mucous membrane of the vulva of an old cow, pregnant, was followed by the formation of a small ulcer and a discharge.

The cow came in heat in a few days, but the symptoms were more pronounced than in ordinary oestrus.

Planted into the prepuce of a rabbit a small ulcer formed with undulating borders surrounding a slightly depressed granular surface.

The heifers in question, one an Angus and the other a Shorthorn, came to the hospital last February with a discharge from the vagina.

The Angus had been to the State fair in November previous, being shipped to and from the fair by rail. No disease of the kind had ever been observed in this herd prior to this outbreak, and it is supposed that the disease was contracted while at the fair or from the stock cars in which the animals were shipped.

There is a bare possibility that the germs might have been brought unintentionally to the Station on

g of an attendant who came from another State  
 ne month before the disease was first noticed.  
 lcers were found on the vaginal membranes of  
 gus, but there was evidence of extensive pre-  
 lcerations. The Angus was supposed to have  
 ted the disease first, gradually acquiring a re-  
 for the microbe, and was on the way to recov-  
 this case the disease yielded readily to antisept-  
 tment.

Shorthorn probably contracted the disease from  
 gus, though a steer occupied a stall between the  
 the barn. This heifer was at the climax of an  
 ttack. There was ecchymosis of the mucous  
 ne of the vagina as far forward as could be seen,  
 tensive exfoliation of the epithelium and ulcer-  
 The discharge was odorless, but dirty, grayish  
 vily turbid.

vagina was irrigated with 2 per cent. creolin  
 and packed with iodoform gauze once per day  
 course of two weeks.

discharge soon ceased, but a kind of stimulation  
 genitals, probably irritation, continued as the  
 was frequently in heat.

um, or heat, recurred every seven to ten days,  
 ted by a swollen and loose condition of the  
 The discharge was somewhat profuse and yel-  
 translucent instead of transparent.

ulcers gradually disappeared from the visible  
 membranes and the application of medicine was  
 nued. About two weeks later the animal was  
 up for final examination and dismissal. But it  
 nd that another crop of ulcers had appeared.  
 ne the catarrh was much less severe, and the  
 ulcers were very few, limited in size and closely  
 ed the one on the prepuce of the inoculated

nimal was subjected to another course of treat-

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ment. Iodoform incorporated in vaseline was applied at intervals of three days by means of a swab of gauze introduced into the vagina and so manipulated as to smear the salve over all parts of the vagina. Rapid improvement followed.

About three weeks later another examination was made and a few small transparent vesicles but none larger than a pin-head were found. These vesicles were kept under observation one week. No change occurred in size, but they became somewhat more rounded and translucent. There was no zone of congested capillaries surrounding the vesicles, but the vaginal mucous membrane remained more congested than normal.

This is believed to be the third crop of colonies.

Where could this renewed infection have come from? The tail and external parts were carefully disinfected and cleaned from all locia. Evidently the source of infection was from the uterus (8) Fig. 12—through the os uteri.

There is no doubt that the microbe inhabits the womb. Law and Moore found it on the "uterine mucous and foetal membranes."

Then, the successive reinfections of the vagina is accounted for by the fact that the microbe growing in the uterus (8) is protected from therapeutic measures by passing out through the os uteri (7) re-establishing footing in the vagina as soon as the field is free of disinfectants. This, doubtless, also accounts for the almost invariable failures, however thorough the measures may have been to rid aborting animals of the infection.

#### *Modes of Distribution.*

1. The infection may be introduced into a herd by the admission of cows or bulls from infected herds. When a newly purchased cow is the carrier, whether she may abort or not, transmits the disease to others.

ly in adjoining stalls, which miscarry, sometimes after another in consecutive order down the line of stalls. The disease may be confined to one side of the stall for years. If the bull distributes the infection, infection occurs promiscuously through the herd.

Allowing the bull to serve infected cows or patting a bull which has served infected cows.

Shipping in cars and keeping in pens or stalls which have been occupied by aborting animals.

An attendant who removes the afterbirth of an infected cow has been known to transmit the disease to other cows operated on afterwards.

It is possible to have the infection transmitted from one herd to another by the interchange of help or securing milkers, herdsman, etc., from dairies where the disease prevails. Overalls and like clothing which have been worn at one farm go with the owner to new localities oftentimes without even a washing.

The manner of handling manure in cow barns where one trench receives the excrement from a whole lot of cows in open stalls may be responsible for the spreading of the disease in the herd. It is the rule to pile manure at one end of the trench and push the manure along until enough accumulates to shovel in quantities, and the discharge from an aborting cow may be scattered behind a dozen or more animals.

Now the germ gains access to the genital organs may be explained as follows:

When the bull is infected, it is easily understood how the germ would be introduced into the vagina at copulation.

There are a number of instances on record where the purchase, borrowing or patronizing of bulls have been responsible for serious outbreaks. More often the disease spreads from one cow to the next nearest, and so on as already indicated.

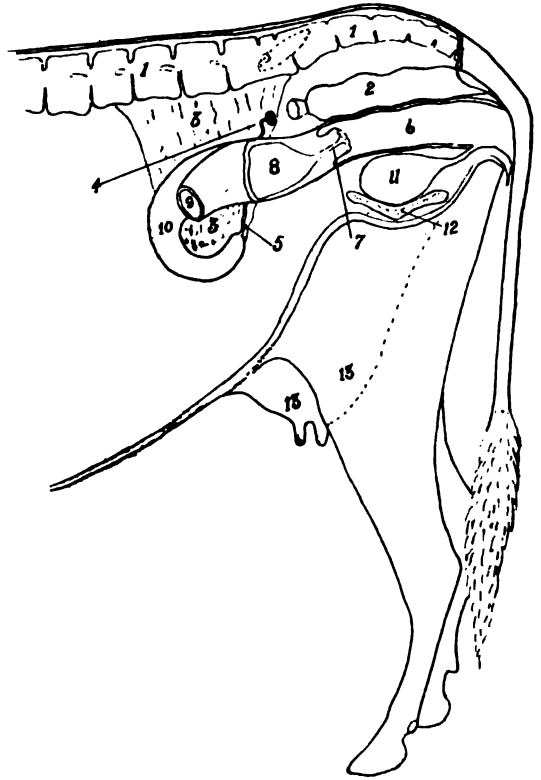


Fig. 12.—1, backbone; 2, rectum or last gut; 3, broad ligament; 4, ovary or pride; 5, Fallopian tube; 6, vagina or first portion of womb; 7, os uteri or opening between the two parts of womb; 8, uterus or deep portion of womb; 9 and 10, horns of womb; 11, bladder; 12, pelvic bone. [Nos. in ( ) refer to Fig. 1.]

In order to understand how this may occur, the reader who has no knowledge of the female genital organs, is referred to the diagram Fig. 12.

To exemplify one possible course the infecting agent might take, we will say: A cow lying in the stall with the switch on the tail soiled in a manure trench, w

been smeared with infection from an aborting sub-

The cow goes out to pasture; the filth dries and is scattered over the rump by the switching tail. Some germs lodge upon the vulva and find their way into the vagina (6) where they multiply with prodigious rapidity. The germs are actively motile, and make their way through the os uteri (7) into the uterus or inner portion of the womb (8), thence through the horns of the womb (9 and 10), and possibly up the Fallopian tubes (5) to the prides or ovaries (4).

Remembering the catarrh caused by the microbe, it would be strange indeed if its presence in the small Fallopian tubes did not sometimes result in obliteration of the passage and sterility. In fact, many animals do become sterile.

*The existence of the Microbe in the Womb.*

The indications are that the germ causing abortion lives in the infected womb for years, though not more than one, two or three abortions may occur. This is not incompatible with our knowledge of germ life. A calf of blood from one of our Southern cattle, apparently in perfect health, injected into the circulation of cattle brought from the North is followed by violent fever, the Texas fever of Southern cattle, or Texas fever. In this way it is proved that an animal which has had no fever for two or more years harbors the living parasite in its blood, and is capable of transmitting the disease to susceptible animals. Authorities are now agreed that the infection causing swine plague, often mistaken for cholera, live in the lungs of the pig after recovery from the acute attack, and continues to be a source of infection for other pigs many months and possibly years. This explains the reason the disease breaks out year after year when once introduced.

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Nelson, after the second year's experience with disease in the herd at the New Jersey Experiment Station, observed that either the microbe had modified life habits to better suit the cow or the cow acquired tolerance for the germ. At any rate, the cow carried her calf longer the second time and often carried the full period the third time. But newly purchased cows were attacked with renewed violence and young cows were more susceptible than old cows. One young cow 1½ years old, aborted 2½ months after conception. Two cows, each 2 years old, aborted at 2 months, while older cows aborted after the fifth month, and in the second year no cow aborted under 6 months.

### *Immunity.*

This tendency on the part of the microbe and the host to adjust themselves to each other results in two or three abortions in a form of immunity. However, immunity in this case is not meant to convey the idea that the cow is rid of the germs, but that she simply will not abort again, while for a long period the germs remain in the womb and may be transmitted to susceptible animals.

**SYMPTOMS.**—The first one or two months of pregnancy abortion occurs without labor pains or straining and sometimes the fœtus lodges for a few hours in the vagina with portions of the fœtal membranes hanging from the vulva or the fœtus may be found in the pasture. If these evidences pass unobserved, the discharge from the vulva may be mistaken for heat, and if the cow refuses the bull then, and allows service the due course of time, the evidence, in connection with the supposed previous pregnancy, though circumstances may be quite conclusive that abortion had occurred.

infectious cases are traced to some misfortune or accident. But cases caused by infection, not being exposed, more frequently pass without due consideration. However, it may be a serious mistake to neglect such cases because of the danger of disseminating the disease. Though many have claimed that abortion seldom occurs before the fifth month, the contrary is quite probable, but, being of apparently little consequence, is not taken into account.

Referring again to Nelson's experience, four cows supposed to be pregnant required service again, and abortion was suspected, though no expelled foetus was found. This supposition was strengthened by the fact that these cows had already aborted or did abort later. In the last half of pregnancy the symptoms are more marked and the consequences more grave.

One, two or three days before delivery the ligaments relax, the flanks sink, the vulva enlarges, and the milk has a colostrum-like appearance. The discharge from the vagina is less transparent than normal—yellowish in cows and white in mares. Labor pains precede delivery. The animal walks around in a circle, looks at the side, lies down and gets up again; strains; and the foetus is expelled.

The foetal membranes pass out with the foetus in the early stages of pregnancy, but are liable to be retained during the last half. This not infrequently happens at regular birth, but more is liable to occur after premature deliveries. The afterbirth may come away in the course of three or four days, and no further trouble is experienced. Occasionally the placenta is retained and it decays in the womb. The animal ceases to run, eats sparingly and irregularly. She stands with the head down, or occasionally turns to look at the side. She is dull, weak and listless. The dis-

charge from the vulva may be profuse or slight, watery and carries more or less decayed tissue, making it heavily turbid and giving a dirty, nasty appearance, and an offensive odor. The tail is soiled by a putrid discharge. Frequent efforts are made to urinate. The animal becomes lean and bony (emaciated) and may linger weeks in this condition. The system finally casts off the putrid matter, and the cow recovers. If the condition grows worse, she grows weaker and weaker until death. Less frequently the animal dies from septic poison.

Prolapsus of the uterus or inversion of the womb is sometimes a sequel to abortion. Inversion of the uterus is recognized by a tumor-like mass projecting from the vulva, moist and red at first, but becoming dark—black—and dry after long exposure.

**TREATMENT.**—Retention of the afterbirth (placenta) and inversion of the womb occur so frequently in connection with abortion that it is deemed advisable to include these accidents in the treatment.

Where the womb is inverted, secure the cow in a narrow stall; wash with 2 per cent. creolin solution and with vaseline or lard and when the cow is not strong replace by pressing against the mass with the palms of the open hands. If the effort is not successful, the womb is inverted again as often as replaced, and the assistance of a surgeon or some one who has had experience with such cases.

An afterbirth retained longer than three or four days should be removed by manual effort. Secure the cow in a narrow, open stall.

The arm bare to the shoulder, is washed in 2 per cent. creolin solution and introduced. The os uterum will be found dilated as long as the afterbirth remains.

nnected with the womb, and should the afterbirth decay in the womb, the os uteri will remain sufficiently open to admit a man's hand long after delivery. (If all the foetal membrane is expelled when the calf is born the os will close in one to three days.) Whatever parts of the afterbirth protrudes from the vulva is grasped by the free hand and gently pulled while the hand in the womb traces the membrane to its attachments and each attachment is separated by teasing with the ends of the fingers.

In neglected cases where the afterbirth has decayed, the membrane will be found in a semi-fluid state collected in the deepest cavities of an apparently paralyzed womb. The putrid content is scraped or scooped out with the hand, fingers kept close together and bent half way to the palm.

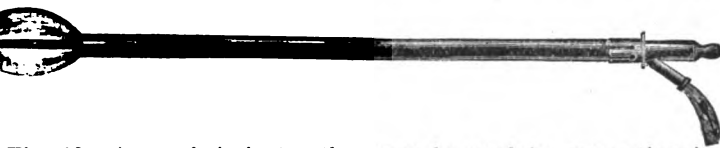


Fig. 13.—A womb irrigator that may be used by connecting it to a fountain syringe.

The womb is flushed, with 2 per cent creolin solution, and again scooped out and the process repeated until the womb is clean. Creolin solution may be introduced by means of an ordinary fountain or rubber bulb syringe with a long rubber discharge tube, the free end being carried arm's length into the womb by the hand.

**PREVENTION.**—Referring now to the disease proper prevention is urged as the only economical course to pursue. Enough has already been said to imply that the infection once introduced will baffle the most careful effort to effect its destruction. Some of the principle means by which the disease is distributed have been detailed



and it is not necessary to refer to the subject again except to urge that no animal be purchased from any where the disease prevails, or has been known to exist in enzootic or epizootic form. Equal care should be exercised over the bull's patronage where the disease is suspected in the vicinity.

After the disease has appeared in the herd the affected animals should be isolated, at any rate given a separate corner in the barn to themselves. And immediately after the bull serves an infected cow the penis and prepuce should be thoroughly disinfected.

The different methods of treatment have given uncertain results:

1. Efforts have been made to control the disease by injecting small quantities of some antiseptic, like boric acid, under the skin at long or short intervals by requiring the animal to consume such remedies with the food. But it is quite probable the only good accomplished was to satisfy the owner until the affected animal acquired immunity.

2. Flushing the womb with solutions of disinfectants have not been attended with the results expected. Persons who have applied these remedies with the greatest care and thoroughness have been surprised to see the disease appear again in the subjects treated. We have already considered the structure of the female genital organs, and it is readily understood how the germs inhabiting the deeper portions of the womb, cut off from the outer portion with the exception of a small opening at the os uteri (7), could escape the most thorough efforts to apply remedies in such manner as to be efficient.

3. Attempts to stamp out the disease by means of antiseptics has met with so little success that some writers have recommended the slaughter of all animals affected. Disposing of the animals with a view to

chasing new subjects is, however, an unsatisfactory practice. All experience goes to prove this. For example, Mörck refers to a herd where the animals were sold off as they aborted and new ones purchased to take the place for a period of eight years without improvement. The owner then resolved to keep the animals at all hazards, and within two years abortion disappeared from the herd. This method would be practicable where the owner is prepared to sacrifice all exposed animals for slaughter and begin business with new stock and in different quarters. A cow, it matters not how valuable her milking qualities, should never be sold for breeding purposes if she is suspected of having infectious abortion.

4. There is another recourse for the breeder; he can establish immunity in his herd. This will, perhaps, entail the loss of two or three calves, for each cow, and a reduction of milk during as many periods of lactation, but, after all, it is doubtless the most economical course to pursue.

In making up a forecast for a line of treatment we are reminded that cows which miss one calving period and abort before the next or those which carry almost full time, often give a full flow of milk, seeming to suffer no inconvenience from the mishap. Also the number of living calves delivered by aborting cows implies that it may be possible to bring the infected cow to the full period of pregnancy, thereby securing a viable calf. Then, presupposing irritation, as previously intimated, to be the active cause of abortion, the first object of treatment should be to tide animals which show signs of aborting over the crisis by giving anodynes. Such a course of treatment gave highly satisfactory results at the Vermont Experiment Station. After four abortions had occurred three out of nine other cows pregnant, showed signs of aborting, but the act was pre-

vented by the administration of laudanum and all animals delivered without accident at the proper time. These animals were kept under the influence of the drug two weeks. Pulverized opium or laudanum may be used. For the cow the powder may be given in 2 or 3 drachm doses, or the laudanum in wine glass doses six hours apart. To counteract the tendency of the opium to constipate the animal one-fourth pound of Epsom salts may be given in the feed or as a drench dissolved in water twice a day. Fluid extract of Indian hemp is a better remedy, if a reliable quality of the drug can be had. Its effect endures longer and it also has the advantage of not interfering with the action of the bowels. The dose is one fluid ounce two or three times a day. In either case the remedy should be given several days, and repeated if necessary.

If by this means cows can be rendered immune without ill effects upon the animal or loss of calf or milk product to the owner, all will be accomplished that could be expected.

Much can be done to prevent the spread of infection by disinfecting infected cows and bulls and premises occupied by such animals. As a matter of fact treatment is not complete without the general use of disinfectants. There is a bare possibility of freeing the animal of infection if the case be taken in hand immediately after delivery before the os uteri (7) has closed. Then the deeper parts of the womb (8) may be irrigated with the solution to be used.

Creolin or lysol in the proportion of 1 part to 50 parts of water is preferable for flushing out the womb. Either solution may be left in the womb with little danger since neither drug is poisonous. However, if the animal does not eject the surplus fluid, which usually happens within half an hour, it may be well to wash out

womb with water which has been boiled and cooled. These applications should be made two or three times a day while the os uteri (7) remains open, but after the os closes the application once a day should be continued for ten days.

Other antiseptic solutions, as carbolic acid 1 to 40 parts water, or corrosive sublimate 1 to 3,000 or 1 to 5,000 parts water, may be used, but requires to be washed out in a very short time because of the poisonous nature of the drugs.

The tail and other parts near the vulva should be frequently cleaned with the antiseptic solution employed.

An ordinary fountain or a rubber bulb syringe may be used for injecting solutions. The nozzle should be carried arm's length into the womb.

To disinfect bulls the nozzle of the syringe is introduced into the prepuce, and the fore-skin is held tightly about the nozzle until the cavity flows full. The practice of irrigating the genital organs with antiseptic solutions just prior to service is not to be encouraged, since conception is very uncertain after such applications. Every precaution should be taken to disinfect premises occupied by aborting animals. All dead foetuses and membranes should be burned or enveloped in quicklime and burned.

Litter in the stall where abortion occurs should be piled up in a corner, or, better, shoveled into a box and mixed with milk of lime (1 measure of freshly slaked lime with 2 measures of water). Mop the stalls with bluestone solution (4 pounds bluestone, 4 pounds fresh lime, dissolved in 40 gallons of water), and whitewash as soon as dry.

Abortion occurring in cows which have been purchased from herds the reputation of which are not known should arouse suspicion and be isolated from other ani-

mals, and not allowed service by a bull kept for general use. Some young or old bull ready for castration may be used to test such cows.

## MILK FEVER.

### DROPPING AFTER CALVING.—PARTURIANT FEVER.

*Cause.*—The cause is unknown.

Opinions on this part of the subject are very numerous and varied. Some claim the disease is caused by growth of bacteria in the udder or the elaboration of bacterial products which are absorbed into the circulation. Others hold that it is due to a bloodless condition of the brain or, on the contrary, to the congestion of the brain.

The view once held that the shock at the time of calving could be responsible for the disorder is hardly tenable, since it seldom, if ever, occurs in connection with difficult parturition. More recent investigators have turned their attention to the modification of the blood, finding it extremely rich and dense, so dense a fact, that the red blood corpuscles are reduced to one-half normal size. Whether this is due to the blood being surcharged with albuminous and fatty matter stored up for the formation of colostrum or first milk failing to be excreted by the udder, or whether the current of nutrition intended for the foetus failing to find its way out through the usual channel, reacts on the system through the blood, has not been determined.

Another line of argument purports to establish a theory that toxic products are produced in the womb and absorbed, leading to a form of intoxication. The arguments adduced are interesting. The fact is pointed out that the os uteri or neck of the womb (7) is open

a long period of time before the expulsion of the fetus, thus admitting infection and allowing time for development of poisonous products. The absorption of these products is facilitated by the absence of a normal placenta in the cow to which the disease seems to be due. The parts are retracted and the blood irregularly distributed in the womb and intestines. This in connection with the presence in the womb of a profuse and semi-solid gelatinuous mucoid substance, different in appearance and far less ropy than the normal liquid discharge after normal delivery particularly favors this idea.

The matter of fact calving is an essential condition; the disease never appears except in connection with calving, usually one or two or three days after that act, though in rare instances, may occur a few hours before calving. Two other conditions, less essential, but quite important, should be mentioned. First, the cow is always a deep milker and in full flesh. Second, the disease occurs in mature cows seldom earlier than the third calving, and when delivery is easy. More or less disorder of the digestive organs always accompany the disease, but this is probably secondary, though some have thought this a source of a part, at least, of the disease.

Some breeds are subject to the malady, but the leading breeds, Jerseys, Holsteins, Guernseys and Ayrshires are the most frequent victims.

Any animal which has once suffered with the disease seems to have it recur at the next calving.

**Symptoms.**—The cow calves with ease, in most instances the afterbirth (placenta) is passed with the calf. The period of time varying from a few hours to three or rarely four days, the cow is in apparently good health.

Then, if the first signs are noticed, the cow

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looks anxiously after the calf; the gate is unsteady, the knees appear weak and the hind quarters rock from side to side, and the hind feet are awkwardly lifted and placed one after another in order to regain equilibrium. This is the treading act sometimes noticed. The tail swings back and forth, following the motion of the body. The temperature is now  $102-103^{\circ}$ , the normal being  $101-102^{\circ}$ . Pulse only slightly accelerated, full strong and regular.

In the course of half an hour the cow staggers, but walks blindly against objects, and, at times, tries to mount the manger. The hind feet are lifted high and awkwardly, appearing to strike at the abdomen and she stumbles over objects and falls completely or over the knees, but rises again. The eyes wander, become wild and glassy or peculiarly lusterless, the rays appear to be reflected rather than transmitted. The head hangs pendant from the withers and is disposed to swing far to one or the other side. The animal seems to lose her balance and falls; falls with the limbs spread as if under the influence of an intoxicant. She is unable to rise again to her feet, but at times, seems to recover, momentarily from a torpor, an effort is made to rise. The result is characteristic. The cow comes up on her knees, but the effort of the hind limbs to balance the posterior part of the body overbalances the anterior brum at the front and the cow tumbles a half lengthward. The pulse is now rapid, weak and irregular, temperature uncertain, but may be  $103-105^{\circ}$ ; head and feet are said to be hot; membranes of the eye red and flow freely. The sphincter muscles at the anus relax, heat radiates from the part and rectal temperature becomes less and less reliable.

After a varying period the torpor passes into complete coma. The cow lies on her breast with her head to

around to one side, the muzzle resting on the ground. This position illustrated in figure 14 is a characteristic

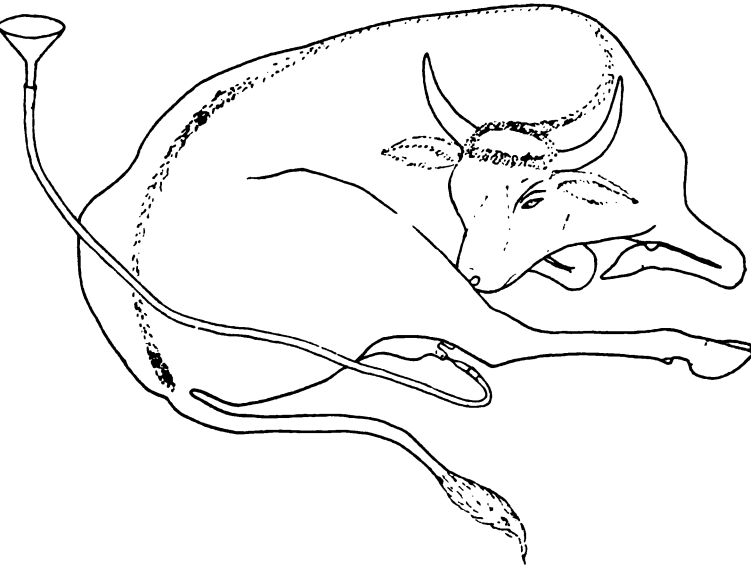


Fig. 14.—Characteristic position of cow in comatose condition. Funnel, rubber tube and milk-tube arranged for injecting Schmidt's solution.

symptom. Or the animal may stretch broadside upon the ground. While in this position the paunch (rumen) is more elevated than the head and fluids from the paunch flow to the head. About one gill of green fluid carrying particles of masticated food in suspension collect in the uppermost nostril. The presence of this fluid accounts for the rattling, gurgling sound which now accompany breathing. The muscular tissue of the gullet (oesophagus) is paralyzed. So, also, are the muscles of the voice box (larynx). Thus, when the head rests on a plane lower than the paunch liquids may



gravitate unhindered to the head, collect in the nose and when the head is raised, which occurs periodically, the fluid flows back to the pharynx, thence between the paralyzed vocal cords and down the wind pipe to the lungs. Ordinarily this would cause violent coughing, but the cow is not now capable of the act. However, in fatal cases, when the wind pipe is opened after death, particles of food are found adhering to the surface of the inflamed mucous membrane. The rattling, gurgling sounds just referred to should be distinguished from the sonorous vocal sounds emitted by animals when no fluids have been allowed to come in contact with the vocal cords. These sounds are low and moaning, and are due to the vibrations of the relaxed vocal cords during expiration.

Sensibility has disappeared, the animal no longer responds to pin pricks. A better test for the comatose state, however, is to place the finger on the eyeball: if the eyelids do not close the animal is insensible. Respirations are slow and indicate deep sleep. Temperature normal or below normal.

*Course*—The disease appears one, two and rarely three or four days after delivery. The sooner the more serious will be the consequences.

Taking a case of average severity, the course will run about as follows: One-half hour after the first symptoms, which are seldom observed, appear, the cow staggers, bellowing and falling; a half to one hour later she is down, but able to make efforts to rise; in two to three hours she lies in a semi-conscious condition, then passes into a state of coma. In order to tell whether the cow is conscious offer to put the finger on the eye, if the eye is not sensitive to the touch, the comatose stage is reached. Coma persists six to fifteen hours in favorable cases, or in fatal cases, until death, which

inspires from one to four days after the first symptoms are noted.

**TREATMENT**—All cows which are heavy milkers and in good flesh, especially cows which have suffered an attack of milk fever, should have the feed reduced, or, what is better, be turned out to find a living on scant pastures. Lean cows are seldom (if ever) attacked, therefore an effort should be made to reduce the cow's flesh as a preventative measure. Some regime of exercise on a reduced food supply should begin not less than two weeks, and longer, if possible, before the cow is due to deliver. The practice of giving a purgative when the cow begins to spring is of questionable utility, if not objectionable. It is not a good practice to give purgatives to heavily pregnant animals. Three courses of medicinal treatment are admissible and attended with varying degrees of success.

1. Give a purgative while the cow is conscious, but by all means never administer drenches after the animal is unable to hold up the head. Medicines are then unable to go down the wind pipe, causing pneumonia and death.

During the comatose stage the animal must be kept braced in a normal position. This is one of the most important features of treatment, and should be executed even if it is necessary to watch over the animal day and night. Bags filled with straw or cotton-seed hulls are very convenient for bracing the animal on the breast. When she lies stretched upon the side, bags should be used to elevate the head as high as the highest part of the body.

For a good purgative use Epsom salts 1 pound, common table salt  $\frac{1}{2}$  pound, ground ginger 1 ounce, and aloes 1 ounce. Mix in two quarts of water; shake and drench.

Drench always through the mouth and never through the nostrils.

2. The second course of treatment aims at the result, *i. e.*, to empty the bowels, but has the advantage of avoiding the dangers of giving drenches. Divide 10 grains of eserine sulphate in three parts, dissolve 2 parts in a little water and inject into the wind pipe at half hour intervals by means of a hypodermic syringe. Repeat in twenty-four (24) hours if the animal shows no signs of recovery. This course is attended with moderate success.

3. The third course is that of Schmidt. This is far the safest and most successful treatment known. 90 per cent. of cases are said to recover.

Dissolve 2 drachms of iodide of potash in one ounce of water which has been boiled and cooled to blood temperature. Inject one-fourth of the solution into each teat after milking out thoroughly. Leave this in the udder 24 hours; milk out and repeat if the animal shows no signs of improvement.

A funnel, rubber tube 3 to 5 feet long, and milk tube connected as illustrated in Fig. 14, may be used for injecting the solution. The milk tube is inserted into the teat and some of the solution is poured into the funnel by an assistant. If the liquid refuses to flow a little compress the rubber tube a few times in the hand. This will force out some of the air and start the flow. If the milk tube cannot be secured, almost any druggist will make a tube that will serve by heating a glass tube of suitable size in an alcohol flame and drawing it out to the proper proportions. Then the broken ends of the glass are rounded in the flame.

A rubber bulb or fountain syringe may be used instead of a funnel. All vessels and apparatus to be

ecting medicine should be thoroughly disinfected  
ing water before use.

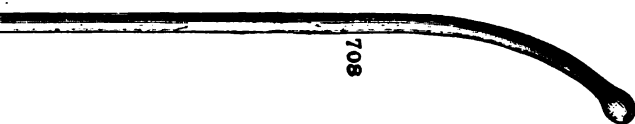


Fig. 15.—Female catheter.

we think it advisable to introduce the hand into  
omb, remove the mucous and portions of placenta  
may have been retained, and irrigate the womb  
per cent. creolin, or some other suitable anti-  
solution. The foregoing courses of treatment  
be supplemented by one-half grain doses of  
nine given hypodermically, or one grain doses  
in capsules on the root of the tongue every three  
r hours. Keep the animal braced in a normal po-  
or the head elevated and expect recovery in 15 to  
ars.

some instances the animal suffers with debility  
recovery from the acute attack. The writer's ex-  
ce with such cases is limited, but usually the  
l eats sparingly, digestion is impaired, and the  
ment softer than normal, and lacking color. If  
is no improvement, death occurs in the course of  
two or three weeks.

the animals never fully overcome the effects of  
ack of milk fever. This is manifested by the re-  
n in milk flow. In order to ascertain approxi-  
y the amount of permanent injury sustained from  
fever, questions were addressed to four parties  
at random, whose cows had been successfully  
d with Schmidt's remedy.

L. H.: Has your cow given as much milk since  
ad milk fever, and how much has been the reduc-

u. "My cow does not give as much as before the

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attack. She gave a little more than three gallons since she has given but little more than two and I have never been able to get her above one-half gallons per day."

Mr. J. T.: "My cow has had two attacks, the first very severe, and the second very mild. There was a reduction of one-half gallon in the milk flow after the first attack, but have not noticed any reduction after the second." "

Mr. S. T.: "My cow has her third calf. Nine months ago she suffered a severe attack of milk fever. The milk yield is now nearly three gallons per day, which is better than at any time in her previous history."

Mr. W.: "My cow suffered a severe attack of milk fever about one month ago. She is 10 or 12 years old. She improved rapidly and as evidence that her system is unimpaired she has a ravenous appetite. She now gives as much milk as ever, about 3 1-2 gallons, without any special feed."

These animals were treated by the writer or by Dr. A. Cary, and we testify that the cases were not milk fever or parturient apoplexy of a severe nature. Each animal passed through a stage of complete anorexia lasting for several hours.

#### INFLAMMATION OF THE UDDER—GARGET—MAMMARY GLANDS—MASTITIS.

The udder of the cow is divided into four quarters or glands or portions, with complete partitions, i. e. no quarter is not connected with another.

Prominent among the causes are imperfect milking, allowing some of the milk to remain in the udder. When the udder becomes infected, curdles, begins to decompose, and inflammation follows.

Heavy milkers are most frequently attacked.

extremely easy and extremely difficult milkers are equally liable. Hard milkers because these are more liable to be imperfectly milked; easy milkers because a drop of milk is often carried suspended to the point of the teat, which, becoming infected, infects the milk within the udder. Milk is an ideal medium for the growth of bacteria. Injuries to the udder, like kicks, blows, etc., and even the calf punching the bag while suckling, are claimed to cause the disease.

### *Symptoms.*

The bag is swollen, feverish, painful, and red with congested blood. Milk flow is reduced, and the milk is changed in appearance and character. The milk is lumpy or watery and may be tinged with blood. As the disease progresses it assumes the appearance of whey, containing shreds or floccules of solid matter. In some cases there is little flow or none from the teat, the bag becomes hard and unyielding, if a hind quarter the inflammation extends far up toward the vulva.

Pus or matter may form and decay progress till the affected quarter literally rots out or if inflammation is limited the pus may be discharged, the bag softens and recovery follows, though the power of the gland to secrete milk may be permanently diminished. Often the diseased products are not cast off through the teat, but an abscess forms between the teats or to one side of the bag, and opens. Pus in varying quantities discharge and stringy, ragged particles of decayed tissue may be drawn out. Such cases are prone to recover after apparently successful treatment.

### *Treatment.*

Prevention: Milk cows with new-born calves, especially heavy milkers, not less than four times a day for

a few days after delivery. Forbid the filthy practice of moistening the teat with milk before milking. Allow no filth from the bedding or portions of the afterbirth to adhere to the udder or to the legs near the udder. Provide clean stables and clean bedding. Cleanliness in all probability, is the best preventative.

Remedial: Treatment is systemic and local. Dress the animal at once with the following: Epsom salt 1 lb., common table salt, 1-2 lb., powdered ginger 1 lb., powdered belladonna (roots or leaves) 1-2 oz., mix with two quarts of water. Supply abundance of clean cool water.

Begin local treatment by injecting into each teat a pint of Schmidt's iodide of potash solution (potassium iodide 2 drachms, water which has been boiled and cooled, one quart.) After the first application inject once per day, 1-2 pint into the affected quarter only.

Rub the affected part once each day with camphor-phosphoric (a saturated solution of camphor gum in carbolic acid 1, carbolic acid 1, camphor 3-5.) This medicine may be applied with the bare hands with perfect safety, and is the remedy par excellence for external use in gangrene. It relieves pain, and penetrating destroys infection and acting as a counter-irritant (a mild blistering agent) softens the parts and hastens absorption of diseased products.

A simple treatment for which much is claimed is the application of water as hot as can be borne, at frequent intervals, followed by glycerine, vaseline or olive oil smeared over the parts. Glycerine is to be preferred. Empty the teats frequently by hand or by means of a milk tube, if necessary. (Fig. 10.)

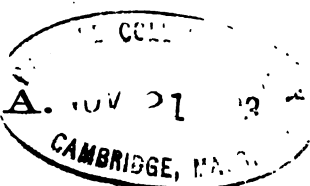
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E. Mead Wilcox.

OCTOBER, 1903.

BULLETIN No. 126.

ALABAMA.



# Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute.

AUBURN.

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## A LEAF-CURL DISEASE OF OAKS.

With 1 plate and 3 text-figures.

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E. MEAD WILCOX, Ph D. (Harvard).

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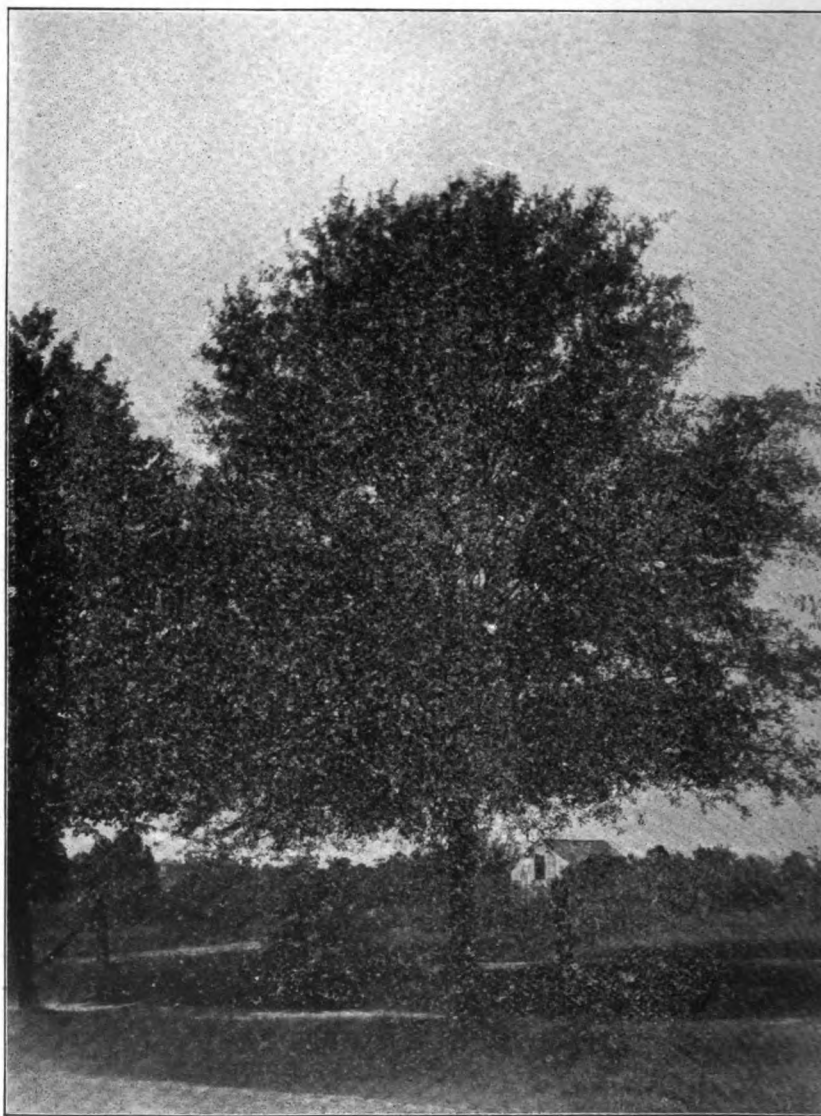


Plate 1.—*Quercus nigra*, one of the common shade trees in Alabama.

# A LEAF-CURL DISEASE OF OAKS.

BY E. MEAD WILCOX.

ral of the native oaks are widely planted and prized in this State as shade trees both along city streets and about private dwellings. No small beauty of a city or town is to be found in the shade trees along its streets. The shade trees about private dwellings add much to the general appearance and attractiveness of the home and contribute largely to the comfort and pleasure of the occupants of the house. In fact, the general condition of the shade trees along the streets of any town may be taken as a fairly accurate index of the prosperity and intelligence of the people of the community. Our people now appreciate the value of good shade trees and are desirous of protecting them against their enemies. The purpose of the present bulletin is to call attention to one of the fungus diseases of some of our native oaks that threatens now to destroy many of these trees, particularly in our cities and towns. If, incidentally, more interest is aroused in home tree adornment through the agency of good shade trees, a useful purpose will have been accomplished in the publication of this bulletin.

It is a pleasure to acknowledge here the kindness of our correspondents in this and other States who have sent the writer specimens and notes of great value. I also to give expression here to my indebtedness to N. L. Britton, Director-in-chief of the N. Y. Botanical Gardens, and members of his staff, and Miss Josephine A. Clark, Librarian of the U. S. Department of Agriculture, for many exceptional favors and helpful assistance rendered in the consultation of the extensive literature in their charge.

## NATIVE OAKS USEFUL AS SHADE TREES IN THIS STATE

The distribution over the state of the oaks the most important for shade purposes in this state for Quotation marks enclose the statements made in the Plant Life of Alabama regarding the special habits of each of the species. The species are arranged alphabetically by the scientific names.

**SCARLET OAK.** (*Quercus coccinea* Muench).—This well known oak is frequent in the mountain region of the "dry uplands, sandy and rocky soil."

**LAUREL OAK.** (*Quercus laurifolia* Michx.).—This species occurs over the southern half of the state and is most characteristic of the central pine belt and the plain. It occurs in "low rich woods." This is one of our most highly prized shade trees on account of its green foliage.

**WATER OAK.** (*Quercus nigra* L.).—This is rather common from the Tennessee river valley south to the coast occurring naturally in "low rich woods and sandy pine-barren swamps." This tree is very commonly planted as a shade tree in every part of the state.

**WILLOW OAK.** (*Quercus phellos* L.).—This species is found from the Tennessee river valley southward to the central pine belt of the state but is not common in the southern half of the state. It occurs "in the borders of swamps. Most frequent in the coastal plain of the Tennessee basin in low woods of a cold damp soil." This is also widely planted as a shade tree and in the towns practically to the exclusion of all other oaks.

**BLACK OAK OR QUERCITRON OAK.** (*Quercus velutina* Lam.).—This species occurs from the Tennessee river valley southward to the central pine belt of the state but is not common in the southern half of the state. It occurs "in the borders of swamps. Most frequent in the coastal plain of the Tennessee basin in low woods of a cold damp soil." This is also widely planted as a shade tree and in the towns practically to the exclusion of all other oaks.

river valley south to the upper portion of the coast pine belt. The bark is the so-called "quercitron bark" employed for tanning and as a dyestuff while the timber is of some value.

**LIVE OAK.** (*Quercus virginiana* Mill.)—This oak occurs only in the coast plain district and rarely extends north of about 31°. This, one of the valuable timber and tanning trees of the state, is at times in the coast plain counties a very important shade tree.

#### SYMPTOMS OF THE DISEASE.

The disease now under consideration makes its appearance early in the spring before the new leaves are mature. A number of grey or bluish spots appear on the leaf and the more rapid growth of the parenchyma of the leaf at these points renders the surface convex on one side and concave on the other. The concave side of this spot or area is frequently on the upper side of the leaf but the spots on the same leaf may show variation in this regard. Some trees have been seen in which the great majority of the concavities were upon the lower surface but this is by no means the rule. These characteristic depressions, or "pockets," in the leaf result from the more rapid growth set up in that part of the leaf by the presence and action of the fungus causing the disease. These areas vary in diameter from 0.25 to 1 cm and are either isolated or confluent. In some of the narrow leaved oaks, such as *Quercus phellos* and *laurifolia*, it is not rare to find the spots confluent over so large a part of the whole leaf that the leaf is as badly curled as occurs in the peach leaf-curl, a closely related disease.

The rapid spread of the disease from one leaf to another may lead to a partial or even complete defoliation

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of the tree in early summer. However serious the break of the disease and the resulting defoliation may be, the tree generally attempts by the formation of new leaves to compensate itself for the foliage lost. In extreme cases of defoliation it is not uncommon to see a tree with an entirely new foliage covering in midsummer. In most cases the second growth of leaves is not badly injured by the disease as was the first and it may entirely escape the attacks of the disease.

It is plain therefore from what has been said that the general effect of the disease upon the tree is much the same as defoliation due to any other cause. The effect of such a disease upon the life of the tree may best be appreciated when one recalls the fact that one of the most important functions of the leaves is to elaborate within their tissues the food material for use by the various parts of the plant in the building up of new tissues and other purposes. Even the roots are dependent upon the leaves for the food required for their growth and the defoliation of the tree may result in the most serious damage to the root system of the plant. Defoliation may result also in the great reduction of the growth in diameter of the stem, and particularly in the reduction in the amount of reserve food material stored up in stems, roots and buds for the following year's growth.

The second growth of leaves results from the proleptic development of buds intended for the following year's growth. And since, as just stated, these buds have but stored in them less food than usual owing to the diseased condition of the foliage of the tree, it is natural that the second growth of leaves developing from them should not be so luxuriant as was the first leaf covering of the tree. Under such conditions, therefore, the tree enters upon the second year's growth with a very small supply of reserve food material. The cumulative effect of the disease may therefore result in many cases in the death of the tree from actual starvation. It is very rare

however that the most severe attack of the disease will result in the death of the tree during the first year.

#### FUNGUS CAUSING THE DISEASE.

The fungus causing this disease is one of the lower *Ascomycetes*, a group characterized by the formation of its spores in small sacs of "asci," singular "ascus." This fungus is very closely related to the *Exoascus deformans* causing the well known leaf-curl disease of peaches. Unlike the latter our fungus does not possess a perennial mycelium and is carried over from one year to another entirely through the agency of the ascospores. These germinate in the spring and form a mycelium that spreads out beneath the cuticle of the leaves of the host to form there a more or less extensive network of hyphæ. From this vegetative mycelium the asci arise in large numbers. These are more or less cylindrical in form and are packed closely together side by side. See Fig. 1.

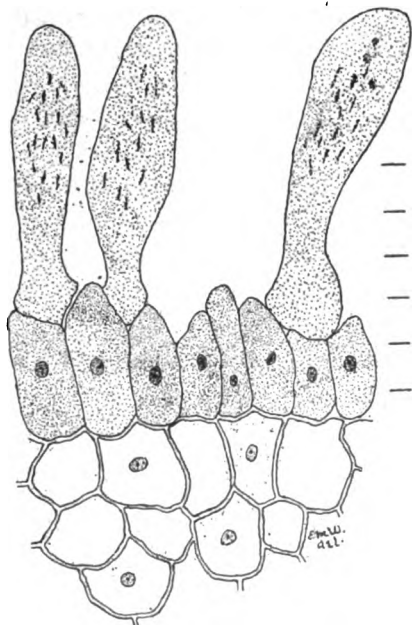


Fig. 1.—Cross section of a portion of a diseased leaf, showing the young asci of the fungus. Each division of the scale is equivalent to 10 mu.



The asci arise between the epidermal cells and the cuticle and break through the cuticle toward maturity.

Each ascus contains at maturity a large number of small spores though it is probable that in younger asci the typical condition is the 8-spored ascus. These or 8 spores however multiply to a large extent within the ascus resulting in the much larger number that is found in the mature asci. The asci in the material examined are from 50 to 75  $\mu$  long and from 25  $\mu$  wide. The spores measured vary from 1.5  $\mu$  in diameter.

As has been mentioned in the discussion of the symptomology of the disease, the asci arise in small round areas upon the surface of the leaf. In the original description of this fungus Desmazieres states that the spots arise on the lower surface of the leaf but this is certainly not uniformly the case. We have noticed that in *Quercus velutina*, the black oak, the spots are generally upon the lower surface only. The same is recorded for this species by Robinson 1887. In *Q. nigra*, the water oak, and some other species the spots occur on both the lower and upper surfaces of the leaf. In all the species examined these spots are at first rather definite but sooner or later several of the spots fuse together so that the spore bearing areas became very indefinite and large.

Like many of the fungi the species under consideration has been referred to under a rather large number of names in the past. Desmazieres in 1848 published a new genus *Ascomyces* Mont. & Desm. to include the single new species *Ascomyces cocrulescens* Mont. & Desm. But the genus *Taphria* had been established by Fries in 1815 who assigned to it but one species, *Taphria populi* now known as *Taphria aurea*. Fries in 1828, however, complicated matters by altering his

hed name *Taphria* to *Taphrina*, to avoid, as he at the time, confusion with *Taphria* a genus of s. Tulasne in 1866 revised the genus *Taphrina* of and made it include also the species of *Exoascus*. son followed Tulasne and Johanson also in ing all the species of the genera *Ascomyces* and *rina* and *Exoascus* in the genus *Taphrina*, as ex l by Tulasne.

ny judgment the plan followed by Schroeter 1894, ing up the original genus *Taphria* Fries is by far est and is in accord with present practices. eter assigns to this genus all those spe- those asci at maturity are multispore and to the *Exoascus Fuckel* he assigns all those species whose t maturity are 8, or rarely 4, spored. In accord- with the above statements our species shold be writ- *phria coerulescens* (Mont. & Desm.) Schroeter, and lowing would be its synonymy:

*Ascomyces coerulescens* Mont. & Desm. 1848.  
*Taphrina coerulescens* (Mont. & Desm.) Tulasne.  
 1866.

*Ascomyces quercus* Cooke. 1878.

*Ascomyces alutaceus* Von Thuemen. 1879.

*Exoascus coerulscens* (Mont. & Desm.) Sade-  
 beck. 1887.

*Taphria coerulescens* (Mont. & Desm.) Schroeter,  
 1894.

#### PREVENTION OF THE DISEASE.

fungus causing the disease now under considera- an annual and its mycelium does not perennate the tissues of the host as is true of many of the y related forms, such as the peach leaf-curl fun- The treatment of such fungi is very much more y carried out than is the case with perennial fungi,

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a portion of whose mycelium lives over winter the host plant itself. In fact in the case of the particular fungus causing this disease no part of the mycelium enters the host plant farther than directly beneath the cuticle of the leaf.

During the spring of 1902 an attempt was made to prevent the appearance of the disease upon a species of the water oak, *Quercus nigra*. The ordinary Bordeaux mixture was employed, made according to the following formula:

Copper sulfate or "blue vitrol".....	4 lbs.
Unslaked lime .....	4 lbs.
Water .....	50 gallons

Place the copper in a coarse cloth sack and dip it by suspending the sack in a wooden vessel holding about 15 gallons of water. The lime is then to be slaked with just enough water to ensure thorough slaking. The slaked lime is then to be made into a paste having a consistency of thick cream by adding water and stirring. When the solutions thus prepared are cold the water is to be poured into the copper sulfate solution through a fine sieve. Water is then to be added to the solution up to the required 50 gallons and the mixture thoroughly stirred before and while using. If too much lime has been employed the solution may injure the foliage and the potassium ferrocyanide test should be applied to determine this point. The test consists in adding to a small sample of the prepared mixture a few drops of a solution of potassium ferrocyanide. In adding one part by weight of the salt to five parts of water. If, upon the addition of a few drops of this solution the bordeaux mixture becomes a reddish-brown color, it is known that not enough lime has been employed in the preparation of the spraying solution. After the addition of more lime test again in the same manner and correct.

the solution ready to use only when no discoloration appears after the addition of a few drops of the test solution to a small sample of the spraying mixture.

The tree employed in our experiment was thoroughly sprayed about ten days before the buds opened and then at intervals of ten days three more sprayings were given. The dates were as follows: February 26, March 9, March 18, and March 26. Of course the first and all subsequent dates must be determined by the advancement of the season. Although the sprayed tree was in close proximity to unsprayed trees of the same species that were badly injured by the disease, the sprayed tree was only very slightly affected by the disease. More extensive experiments must be undertaken before one could say with any certainty that this line of treatment will in all cases be effectual in preventing the outbreak of this disease. But the one positive demonstration of the value of this treatment renders it very probable that the disease may be held in check by such treatment as that outlined above. It is expected that further experiments along this line will be undertaken during the coming spring with several species of oaks that are known to have had this disease during the present season.

#### HOST INDEX OF THE FUNGUS.

The fungus now under consideration has been reported as occurring on the following species of oaks in the states named.

*Quercus alba* L. White Oak. Conn. N. J.

*Quercus brevifolia* (Lam.) Sargent. Blue Jack. Ala. Car.

*Quercus coccinea* Muench. N. J. Wisc.

*Quercus digitata* (Marsh.) Sudworth. Spanish Oak. Ala.

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*Quercus laurifolia* Michx. Laurel Oak. Fla.  
*Quercus marylandica* Muench. Black Jack. Ala.  
*Quercus minor* (Marsh.) Sargent. Ala.  
*Quercus nigra* L. Water Oak. Ala. Fla.  
*Quercus phellos* L. Willow Oak. Ala. Fla.  
*Quercus rubra* L. Red Oak. N. H. N. Y.

#### GEOGRAPHICAL DISTRIBUTION OF THE DISEASE

The distribution of this disease by states is shown in Figure 2.

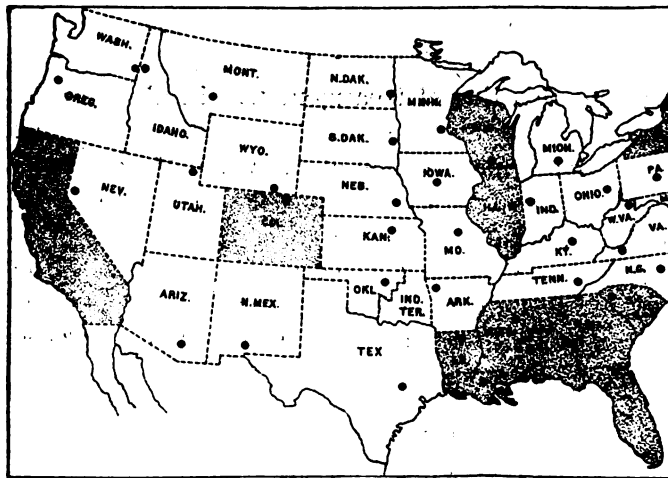


Fig. 2.—The disease described in this Bulletin is known to exist in the states shaded.

It is very likely that the particular fungus causing the disease herein considered is found outside of the states there indicated but serious outbreaks of the disease are to be expected only in the gulf states. It would appear that the climatic and other conditions are more favorable to the development of the disease in this region.

than those prevailing to the north and west. Specimens of leaves showing the disease and the fungus herein described have been examined by the writer from the following States: Alabama, California, Colorado, Connecticut, Florida, Georgia, Illinois, Louisiana, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, Rhode Island, South Carolina and Wisconsin.

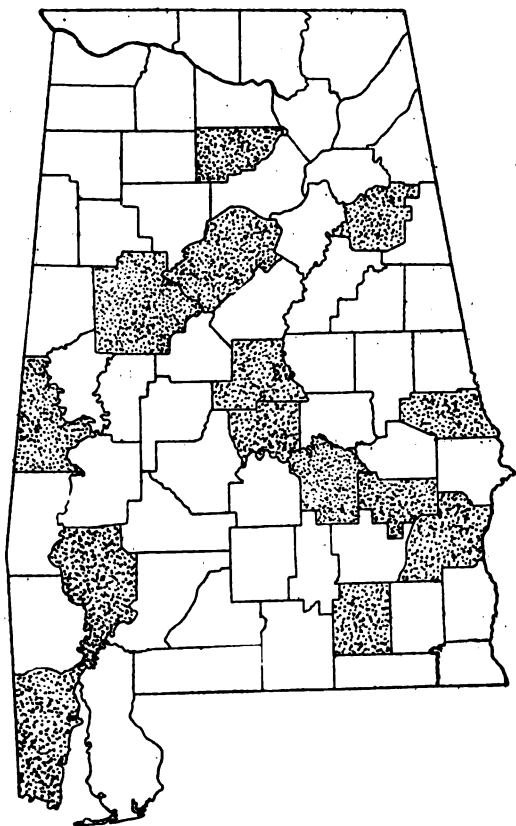


Fig. 3.—The disease described in this Bulletin is known to be present in the counties shaded.

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In figure 3 is shown the local distribution of the disease in this State by counties so far as the writer has been able to examine material. The disease now does much damage in every county of the State but particularly in the counties south of the Tennessee valley. Material of the disease has been examined in the following counties: Autauga, Barbour, Bullock, Chilton, Clarke, Coffee, Cullman, Jefferson, Mobile, Montgomery, Sumter and Tuscaloosa.

#### OTHER SPECIES CLOSELY RELATED TO *TAPHRIA COERULESCENS*

The following notes upon related species described as growing upon species of *Quercus* may be of interest.

*Ascomyces extensus* Peck. 1886. Reported on leaves of *Quercus macrocarpa* from New York state.

*Eoascus kruchii* Vuillemin. 1891. This species was found by Kruch in Italy upon leaves of *Quercus ilicis*, and is by Schroeter referred to *Taphria*.

*Ascomyces quercus* Cooke. 1878. This was reported by Cook in Rovenel's American Fungi upon leaves of *Quercus cinerea*. It is identical with our *Taphria cocrulescens*.

*Ascomyces rubro-brunneus* Peck. 1887. This was reported by Peck upon leaves of *Quercus tinctoria*.

It is quite probable that all the above species belong to the genus *Taphria* but their specific standing we have not determined with sufficient certainty to refer to them under that name in this connection.

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E.

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**ALABAMA.**

# **Agricultural Experiment Station**

OF THE

**Alabama Polytechnic Institute.**

**AUBURN.**

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## **Alfalfa in Alabama.**

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By

**J. F. DUGGAR, Director and Agriculturist.**

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## ALFALFA IN ALABAMA.

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BY J. F. DUGGAR.

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The present bulletin combines the results of experiments made by this station and the experience of a number of farmers who have begun to grow alfalfa in different parts of the State, as kindly furnished in correspondence with the writer. This is intended as a preliminary report. Extensive experiments on alfalfa in co-operation with the United States Department of Agriculture were undertaken by this station during the fall of 1903. It is our expectation to present those results, and others, in a future publication.

Alfalfa, or lucern, (*Medicago sativa*), belongs to the family of plants that normally bear enlargements or tubercles on their roots, through which these plants are able to take the nitrogen of the air. Alfalfa is a perennial, living for many years without reseeding. Great numbers of buds put out from the old root each year as soon as the coldest portion of the winter is past.

During the first few months of its life alfalfa may be regarded as a tender plant, both as regards cold and drought. After it has passed through its first summer, alfalfa is extremely resistant both to cold and to drought. The name lucern, which also is properly applied to alfalfa, has led some men, unfamiliar with alfalfa and acquainted with sweet clover or melilotus, sometimes indirectly called lucern, to confuse the two plants. These

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are much alike when young. Alfalfa is a much smaller fine stemmed plant, having purple blossoms and a seed pod.

Alfalfa has, for many centuries, been an important plant, especially in the warmer portions of Europe. Above all other crops alfalfa may be credited with the foremost place in the development of the arid region of the United States. At no distant day it will doubtless assume important proportions in the agriculture of Arizona. On all soils suitable to it in this State, it will doubtless become one of the principal foundations upon which the live stock industry will be based.

#### USES.

Alfalfa is useful for hay making, for feeding green (soiling), for pasturage, and for the fertilization of soil. Its most important use is as a hay plant. Alfalfa yields more hay per acre than any other leguminous forage plant. Indeed, in yield it has few superiors, sorghum perhaps being the only one of importance in Arizona, and this falling far behind alfalfa in nutritive value. Alfalfa hay is much more nearly a complete food than the hay of Johnson grass, sorghum, crab grass, etc.

The following table gives the composition of green and cured alfalfa, and for comparison the composition of certain other forage plants, the chemical data being taken from Henry's "Feeds and Feeding" and from McBride's tables.

*Pounds of food material in 100 pounds of forage.*

	Protein or muscle- formers.	Starch, sugar, etc.	Fat, wax, etc.	Woody fiber.	Ash.	Water.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
alfalfa hay . . . . .	14	43	2	25	7	9
cow pea hay . . . . .	17	42	2	20	8	11
Johnson grass hay . . . . .	7	46	2	29	6	10
crab grass hay . . . . .	7.8	45	2	28	8	9.2
dried corn blades . . . . .	6	36	1	22	5	30
berghum hay (verydry.) . . . . .	4	37	3	24	4	28
green alfalfa . . . . .	5	12	1	7	3	72
green rye . . . . .	2.6	7	.6	12	2	75.8

The nutrients of most value are those in the first three columns. An *average* quality of cowpea and of berghum hay is believed to be a little poorer, and corn blades (fodder) a little richer, than shown by the figures in the table.

From the above table it will be seen that alfalfa is about as rich as other hays and corn blades in starchy materials and sugar, and about twice as rich in muscle-forming material. Alfalfa hay is about equal in composition to the best grades of cow pea hay, but is not so coarse. Alfalfa hay is suitable for horses, cattle of all ages, and sheep. It is sometimes used in the Southwest as the exclusive food for farm teams, but it is generally advisable for working animals to have some corn in addition to alfalfa. However, the use of alfalfa hay greatly reduces the amount of corn necessary to keep working

teams in condition. For six weeks last summer C. Webb, of Demopolis, Ala., fed all the mules on his plantations on alfalfa alone. Although they work they kept in satisfactory condition. Alfalfa has also been successfully used as part of the ration for hogs. Alfalfa hay is similar to melilotus in composition, but much more palatable. It is less bulky, makes a better appearance, and, unlike melilotus, is salable.

As a soiling plant, alfalfa may be utilized throughout every portion of Alabama, since the small area needed for this purpose will enable the soil to be suitably manured or limed or otherwise brought into condition for successful growth. The especial advantage of alfalfa soiling is the early date at which it is available, making it the only other practicable crop which may be sown early in the season. Alfalfa remains green throughout the year except in December, January, and February. In Central Alabama, alfalfa has been cut for food for hogs as early as March 11. In nutritive qualities, green alfalfa is decidedly superior to green rye, and is eaten with relish by all farm stock and poultry.

Alfalfa is sometimes used as a pasture plant on small areas, which it is well adapted, but is too valuable for soiling to justify its general use for pasturage, unless the acreage in alfalfa is greater than is needed for hay making and soiling. Pasturage shortens the life of the alfalfa plant by enabling weeds to outgrow it, and by crowding the soil too closely around the crown and roots, and also by the injury resulting from very close continuous grazing. Stock should never run on an alfalfa pasture when the ground is wet or frozen, nor during the first year after the seed are sown. Cattle and sheep are liable to bloat when grazing on alfalfa. It is safer for horses, and perfectly safe for hogs.

can afford to graze cattle or sheep on alfalfa unless thoroughly informed in regard to all possible precautions for decreasing the amount of bloat and unless he has a surplus of alfalfa over and above that which he can use for hay and soiling. The principal precautions against bloat are (1) feeding dry food before cattle or sheep are first turned on alfalfa; (2) gradually lengthening the daily grazing period; (3) allowing stock grazing on alfalfa to have access at the same time to a pasture containing palatable grass.

Alfalfa makes an unrivaled pasture for hogs. One may conservatively estimate an acre of good alfalfa pasture as capable of supporting a sufficient number of hogs to weigh at least 1,000 pounds. This record has been greatly exceeded. F. D. Coburn says: "Ten young hogs per acre will not damage alfalfa, and should make 1,000 pounds of gain in a season, under ordinary conditions, without grain." While hogs make satisfactory and economical growth on green alfalfa alone, they more completely utilize this crop when a little corn is fed. Alfalfa used as a hog pasture, should be mowed whenever it becomes tall or coarse, to promote fresh tender growth. Rings in the hogs' noses are advisable to prevent destruction of alfalfa pastures by rooting. The young shoots on alfalfa remain green practically all winter in central Alabama.

Alfalfa has been made into silage with varying success. In our climate where we have frequent rains, the silo might prove a profitable means of utilizing cuttings of alfalfa too much injured by rains to make good hay, but still succulent.

In Alabama alfalfa should be used for soil-improvement only after it has outlived its usefulness as a food plant. Alfalfa greatly enriches the soil in nitrogen gathered from the air.

## YIELDS OF ALFALFA HAY.

The following estimates of their yields of alfalfa obtained are reported in correspondence by the persons named below:

Total no. tons. per acre.	No. cuttings.	Reported by	County.	1st cut
3 unmanured	4 to 7	J. C. Webb.....	Marengo.....	May
5 to 6 manured	4 to 5	J. I. Thornton.....	Greene.....	May
4 to 5				
1½ medium land	4	Dr. W. J. McCain.....	Sumter.....	May
5 on bottoms	3	P. G. Lightfoot.....	Greene.....	May
½ to 2½		E. F. Bouchelle.....	Greene.....	April 20,
.....	3 or 4	J. O. Hays.....	Greene.....	May
1 to 5	3 or 4	S. Selden .....	Greene.....	April
2 to 4	4 to 6			
1½ prairie		J. McKee Gould, Jr....	Greene.....	May
1 post oak				
0 sandy land				
.....	4	W. M. Hill.....	Hale.....	May
.....	4 or 5	B. B. Rudolph.....	Lowndes.....	May
3.....	3	M. H. Traylor.....	Lowndes	Fall sowing
.....				Spring sowing
1 to 3.....	4	J. A. Dillard .....	Montgomery.....	May
3.....	3	Judge W. H. Tayloe....	Marengo .....	
.....	4	Cobb & Macmillan .....	Sumter.....	April
2½.....	3	E. H. Allison.....	Morgan.....	

The yields estimated by the above named alfalfa growers as the average production under their conditions indicate that after the first season alfalfa can be cut three to six times (usually 4 times), and that the yield of alfalfa on good land is three or six tons per acre. Land producing less than two tons per acre may yield a profit, but should not be selected for alfalfa without being fertilized with some legume, with manure, or with fertilizers.

The most usual date for the first cutting as found by the above named growers is about the first of May or earlier. When sown in the spring one would expect no cutting of consequence for a month later, and much less than a normal yield the first season of growth. On poor land with unfavorable seasons no cuttings worth raking are obtained during the first season from spring sowing.

following extract from Bulletin No. 20 of the  
ma Canebrake Experiment Station, at Uniontown,  
red by the writer, illustrates the possibility of ob-  
g from prairie soils large yields of alfalfa the first  
, even from spring sowing.

tract of dark pebbly hillside of medium fertility  
lowed and harrowed, and alfalfa seed was sown  
east on March 20, 1903. The stand was so thick  
veeds were not troublesome until the growth of al-  
was checked by drought, which prevailed almost  
uously from about the middle of August until No-

r.  
to that time alfalfa made rapid growth and af-  
l three cuttings by September 3. Because of con-  
s dry weather, growth after that date was too slow  
other cutting to be obtained, though with the ordi-  
rainfall of September and October a fourth cut-  
ould doubtless have been secured.

is alfalfa occupied all of 'Cut 23' except 1-20th of  
e, used for another forage plant. The area of this  
according to a survey made by Mr. T. M. Cocoran,  
5-100 of an acre. Mr. Corcoran's survey is made  
sis of the calculated yield per acre in the follow-  
ble.

ch cutting of hay required only one day in curing.  
s then regarded by Mr. Richeson as dry enough to  
in the barn, where it kept without molding.  
e yields of hay thus cured were as follows:

	Lbs. per plot.	Lbs. per acre.
16 .....	1,030	1,871
15 .....	1,682	3,058
3 .....	1,922	3,495
	<hr/>	<hr/>
al .....	4,634	8,424

"This shows a yield of more than four tons of hay per acre when stored. It would probably not be safe to regard this as thoroughly cured hay, suitable for stock in large masses. If, to be thoroughly conservative, we assume that a further drying out to the extent of 25 per cent. after being placed in the barn would be necessary before we could regard this as thoroughly cured hay, it should still have a yield of more than three tons per acre. This is an unusually large yield for spring alfalfa in its first season of growth, and is probably as much as can *ordinarily* be expected from very young alfalfa, even when sown in the fall. The conditions producing this large yield were a thick stand, abundant rains from March to August, thorough surface drainage, and a supply of root tubercles.

"To emphasize the statement that this was upland prairie land of a fair degree of fertility, the following facts are mentioned: Corn without fertilizer and without any special treatment, averaged in the two years which bordered the alfalfa area 21 bushels per acre. Land sown to alfalfa in March, 1903, was in 1902 in corn, without fertilizer; and in 1901 it had borne a crop of corn without cowpeas. No stable manure had been applied in very recent years, and it is not known whether any manure had ever been applied."

The following is another instance showing the possibility of getting good yields from alfalfa the first season even when sown in spring.

Mr. W. L. Ennis, Livingston, Ala., reports as follows: "Sowed 23 pounds of alfalfa seed, inoculated with bacteria from a bur clover field, on March 20, 1903, on the upland land we had, about one acre. Yields of baled hay were as follows:

"First cutting, 21 bales; second cutting, 40 bales; third cutting, 17 bales. Total, 97 bales. Average weight of bales 104 1-2 pounds." This is about 5 tons per acre.

## PRICES AND PROFITS.

Those Alabama alfalfa growers who have sold alfalfa report that the price in recent years has been not less than \$13 to \$15 per ton. Even if we assume a minimum yield of 4 tons of hay per acre on land to which alfalfa is adapted, and a minimum price of \$10 per ton, there would still be larger profits in growing alfalfa than most other field crops. Captain John C. Webb, of Demopolis, Ala., writes: "It has paid me better than any other crop I ever planted."

Mr. W. L. Foster is reported in Louisiana Bulletin No. 72 as follows in regard to alfalfa in the bottoms of the Red River, near Shreveport: "It costs an average of \$1.25 to \$2.00 per ton to put [alfalfa hay] in shape for the market."

The books of another alfalfa grower in the same region showed a cost of \$1.90 per ton to cut, cure, market, and bale a crop of this hay.

The same publication contains this significant paragraph as to the profits of alfalfa in that region:

"When the land is seeded to alfalfa by the owner and rented out, he gets fifteen dollars an acre, and the renter furnishes his own harvesting tools, or he gets eighteen dollars rent and furnishes the harvesting tools. This is on land that rents for five dollars an acre for cotton."

## SOILS FOR ALFALFA.

At present the most important question in connection with alfalfa in Alabama is the determination of soils on which it can be made a profitable crop. In determining the best soils for alfalfa we shall be helped by bearing in mind that this plant needs a soil (1) well supplied with moisture, (2) well drained, (3) having an abundance of lime, (4) rich in other plant food.

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Alfalfa is at its best when grown under irrigation, which fact indicates its response to large amount of water judiciously applied. In humid regions alfalfa is pre-eminently a crop for valleys, because on these levels there is a relative abundance of moisture even during dry seasons. On the other hand, the roots of alfalfa in congenial, well drained, permeable soils, penetrate to great depths in search of moisture. But with the drainage in a large part of the south this habit of alfalfa is not fully utilized. The need for ample supplies of moisture can be better understood by the statement that ordinarily hay plants must pass through their leaves about 400 tons of water for every ton of hay produced, or 1,600 tons of water per acre for every crop of four tons.

Drainage, important for most ordinary farm crops, is caused by the need of the roots for air, and because the deeper growth of roots in drained soil, is doubly important for any leguminous or soil-improving plant such as alfalfa. For not only do the roots of such plants need water, but the nitrogen-fixing bacteria in the root nodules must have thorough soil ventilation in order to perform their work of transforming the valueless nitrogen of the air into the valuable nitrogen of plant food. Whatever may be thought by some of the sufficiency of shallow ditches and levees for draining prairie land sufficient for cotton and corn, it is certain that such mere surface drainage is insufficient for alfalfa, as, indeed, we believe it to be for the maximum results with other crops. In such cases deeper ditches are needed for alfalfa.

No argument is needed to show the greater convenience and saving of land and work if some of these ditches could be converted into underground drains, whether of plank, pole drains, or whether tile be the material employed. If tile drainage in Alabama can be shown to be cheap enough and continuous

active for any field crop, that crop will be alfalfa. A few farmers owning land valued only at \$25 per acre will be found at present willing to make the large expenditure necessary for tile drainage, and an investment will doubtless be found feasible on certain stiff bottom lands, otherwise peculiarly adapted to alfalfa, especially as these lands advance in price because of their suitability to alfalfa. The establishment of tile factories in the south, or the co-operative purchase of tile machines would so greatly cheapen the cost of tile drainage as to make it practicable for alfalfa fields and other land farmed intensively.

Alfalfa should endure for many years. One of our correspondents has alfalfa plants seventeen years old growing on prairie land. If a field of alfalfa, free from disease and from excessive growth of weeds, begins to decay when only a few years old, deficient drainage may be suspected. Alfalfa is usually spoken of as needing an alluvial soil. While permeability is desirable, yet in Alabama the soils to which it has thus far proved best adapted are lime soils of close texture.

#### PRAIRIE SOILS.

Taking up the different soils somewhat in the order of their proved or probable fitness for alfalfa we must deal first with the Central Prairie Region of Alabama, extending from Union Springs in a northwest direction past Montgomery, Selma, Uniontown, Demopolis, and Livingston, and into Mississippi. In this region a few very small patches of alfalfa were grown many years ago. So far as I can learn, Capt. J. C. Webb, of Demopolis, was the first one in that part of the State to grow alfalfa on any considerable scale. One of his earliest plantings was made on a shallow gray soil underlaid near the surface with white rotten limestone. This field lay next to the

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Tombigbee bluffs, on the western edge of Demopolis, and hence was well drained. Steers had been fed here on cottonseed meal and hulls, and the growth of alfalfa was most satisfactory. Capt. Webb has since largely increased the area which he devotes to alfalfa. The principal part of the alfalfa area of Alabama is now in Greene and Sumter counties.

Prairie soils may be subdivided into quite a number of classes merging into each other by imperceptible gradations. Those prairie soils are best suited to this crop which are best drained and best supplied with vegetable matter.

Extensive inquiries were made of a number of growers of alfalfa in Alabama, and below follows a summary of their answers to the question as to the character of soil in the prairie region best suited to alfalfa.

All expressing an opinion preferred lime to sandy clay soils. Black prairie is the choice of most of the correspondents, some of these expressly naming black bottoms or slough land, others fertile black upland soil. Those who prefer bottom land specify bottoms that are well drained. Two prefer "hammock" land, one of them describing his favorite alfalfa soil as "alluvial land overlaying stiff prairie." One chooses shelly prairie, one cedar "hammock," and one gray upland prairie and "hammock," and another yellow prairie. One correspondent has succeeded best in growing alfalfa on the mixed soil at the base of white marl hills.

On the farm of the Canebrake Experiment Station Uniontown, alfalfa has done remarkably well during its first year's growth on upland of medium quality, and containing a small number of rough pebbles. We are not from recommending alfalfa for that grade of prairie soil that consists *largely* of these roughened pebbles and that is too poor to make fair crops of cotton. Alfalfa needs fertile soil.

Answering the question what soils are unfit for alfalfa, these correspondents are almost unanimous in naming sandy soils. Three (including one farmer who has a very large acreage in alfalfa) specify post oak, and one especially designates black post oak.

With the confessedly incomplete data now available the soils of the prairie region of Alabama may be tentatively ranked in about the following order as regards their suitability for alfalfa:

*First class:* Black bottoms, well drained, and drain-alluvial lime bottoms containing a little sand.

*Second class:* Black uplands; shelly gray uplands, and rich chocolate uplands.

*Third class:* Poor gray to white prairie, and poor, stiff red or post oak land.

#### OTHER LIME SOILS.

As to the suitability to alfalfa of the soils of the remainder of the State, there is much less evidence available. From theoretical considerations there is every reason for expecting alfalfa to succeed in all the lime soils of the Tennessee Valley region, and in the narrow river valleys in the northeastern part of the State.

Messrs. E. H. Allison and R. P. McEntire, of Decatur, write of their success with alfalfa in that part of the Tennessee Valley, and other instances of success in that part of the State have been heard of, but not confirmed by answers to our inquiries.

There is reason to expect the best red calcareous soils of Talladega, Calhoun, and counties north of these, to give satisfactory results with alfalfa. In a word, there is a prospect for the successful growth of alfalfa on rich, well drained lime soils in any part of the State where they occur.

Rich bottoms in every part of the State, if not subject

to long or otherwise injurious overflows, and no wet or too sandy, are probably suitable for alfalfa. If they are deficient in lime it can be added with the possibility of profit.

#### SANDY SOILS.

While it is possible that alfalfa can be grown in garden conditions, on almost any soils in Alabama, it is probable that it will not be a profitable sale crop on upland sandy or clay soils deficient in lime unless they are exceptionally rich. In order for it to be grown successfully, on these soils, great care will be required and in many cases heavy applications of manure or lime (the latter being supplemented by small amounts of commercial fertilizers) will be necessary. Then becomes a question whether it is more profitable to grow these sandy uplands thus to coddle alfalfa or to raise harder forage plants, as hairy vetch, cowpeas, soy beans, sorghum, etc. We are certainly not yet in a position to recommend alfalfa for non-calcareous upland soils except on a very small scale. However, the great value of the plant on congenial soil makes it worthy of trial in a small way on every class of soils.

#### LOCAL EXPERIMENTS IN PROGRESS.

To determine the suitability to alfalfa of each of the principal soils of the State, this station in co-operation with the United States Department of Agriculture has arranged for an experiment with alfalfa in every county in Alabama. The unusually dry fall, delaying late planting, and the early occurrence of frosts and freezes, destroyed the stand of alfalfa in many of the experiments referred to. It is planned to continue the work along this line.

## FERTILIZERS FOR ALFALFA.

One ton of alfalfa hay contains approximately 44 lbs. of nitrogen, 10.2 lbs. of phosphoric acid, and 33.6 lbs. of potash. Hence a crop of four tons contains as much nitrogen as is found in 2,450 lbs. of cotton seed meal, as much phosphoric acid as is contained in 336 lbs. of high grade acid phosphate, and as much potash as is contained in 1,075 lbs. of kainit. It would cost, to buy all these amounts of plant food in the form of commercial fertilizers, approximately \$35.00. Fortunately not all of this is removed from the soil, the greater part being the value of the nitrogen, the largest proportion of which the alfalfa doubtless gets from the air. It would, however, require about \$8.75 worth of phosphate and kainit to replace the amount of phosphoric acid and potash which would be removed from the soil of an acre by a crop of four tons. Hence it is evident that even the richest prairie soils, if cropped for many years in alfalfa, will need to have their supplies of phosphoric acid and potash replenished by the application of manure or fertilizers. This will be especially true if Johnson grass hay has previously been removed from these soils for a number of years, thus making heavy drafts on the soil's supply of these two minerals.

According to Wolff, one ton of alfalfa hay contains 70 pounds of lime, or 280 pounds in a crop of four tons. In three experiments on the station farm at Auburn lime has proved highly beneficial to the growth, permanency and hardness of alfalfa.

In the case of soils not rich in lime it will be necessary from the beginning to apply this material, as is clearly shown in the experiments on the station farm at Auburn. Not only do lime and phosphoric acid directly stimulate the growth of alfalfa on soils deficient in these min-

erals, but their presence is believed to favor the development of tubercles, on the abundance of which largely depends the thrift of the alfalfa plant. From 6 to 12 bushels, equal to  $\frac{1}{2}$  to 1 ton of unslaked lime, or to at least 1  $\frac{1}{2}$  tons after slaking, may be applied per acre. Liming (or the use of manure or wood ashes) will be indispensable for alfalfa on acid soils, of which there are many areas in Alabama. To test a soil for acidity, a strip of blue litmus paper should be kept in contact with moist soil until damp. If the soil is acid the color of the paper will change to pink. On application to the writer, litmus paper for this test will be furnished free.

Where there is no local experience to guide one in selecting fertilizer, the following formula (or stable manure), is suggested as a fertilizer for alfalfa, in regions where the use of commercial fertilizers is general:

400 pounds acid phosphate per acre and 50 pounds muriate of potash per acre.

The above is not intended to take the place of lime where the soil is deficient in lime, but to supplement it. When lime and acid phosphate are both used for any crop they should be applied separately, and one should be worked into the soil before the other is applied. Tubercles on the roots of alfalfa should supply it with nitrogen. But if the roots are devoid of tubercles, nitrate of soda or cotton seed may be needed.

#### FERTILIZER EXPERIMENTS AT AUBURN.

On reddish sandy upland soil at Auburn, capable of producing only about 10 to 12 bushels of corn per acre without fertilizer, ten plots of alfalfa were sown, October 29, 1900. The soil was not acid. All plots were at that time fertilized at the same rate per acre, namely 320 pounds of acid phosphate and 80 pounds of sulphur.

potash. An effort was made to inoculate the seed, but this was not entirely successful.

A good stand of plants was found on all plots the latter part of the following March and the early part of April, when different nitrogenous fertilizers were applied to these plots as shown in the next table.

Alfalfa made extremely poor growth in 1901 on the plots receiving no manure. On all plots, weeds, leaf rust, sclerotial disease of the roots, and perhaps nitrogen starvation, killed the larger part of the plants. The lime and the stable manure plots suffered least and kept the best stands. No plot made a yield worth harvesting separately. October 7, 1901, without plowing, an additional amount of seed was disced in on all plots.

Again in the phenomenally dry summer of 1902, the alfalfa on *most* plots did not yield enough hay to justify turning it up. However, the plots were clipped four times in 1902—May 6, June 17, Sept. 13, and October 13.

On the best plots, those to which stable manure had been applied about 15 months before, and which were now reduced by disease and dry weather to a mere fraction of a stand, the yield was only about one ton of hay for the entire season. The extreme drought of 1902, extending practically from the middle of April to August, will be recalled by most readers.

In the summer of 1902, the poorest plots of alfalfa were plowed up and planted in New Era cow peas in 1903. These made slight growth, but were kept clean by late cultivation. The plots then plowed up as being the poorest were those which 18 months before had received per acre either 200 pounds of nitrate of soda or 100 pounds of cotton seed meal or no fertilizer.

September 13, 1902, inoculated alfalfa seed, 20 lbs. per acre, were sown on these plots, first running a



disc harrow several times over the small growth of pea vines, a procedure that in ordinary seasons would not suffice to dispose of a crop of cow peas of the luxuriance, but which is sometimes a satisfactory method of cow pea stubble. On all these plots and nearly all other plots, 2,000 lbs. of slaked lime (equal to about 4,000 lbs. of unslaked lime) were harrowed in. Next year on certain other plots where the stand had become very thin were plowed and sown in alfalfa.

The stand of alfalfa on other plots, (those established eighteen months before had been fertilized with manure or lime), was thickened by drilling in with a grain drill a small amount of alfalfa seed, mixed with sand to make the distribution more uniform.

The yields of hay obtained in 1903 on each plot are shown in the following table:

Pl		May	July	Sept	Total
1	Sept. 13, 1902.....	.....	700	900	1600
2	Sept. 13, 1902..... Drilled.	.....	500	1000	1500
3	Sept. 13, 1902.....	.....	1100	1200	2300
4	March 18, 1903.....	.....	1600	2000	3600
5	Oct. 29, 1900.....	2300	2050	2300	6700
6	Oct. 29, 1900.....	2400	2200	2200	6800
7	March 18, 1903.....	.....	900	1600	2500
8	Oct. 29, 1900.....	1400	1100	2000	4500
9	March 18, 1903.....	.....	800	1000	1800
10	March 18, 1903.....	.....	900	1300	2200

{ 320 lbs. acid phosphate  
80 lbs. sulphate potash.

{ 200 lbs. nitrate of soda.  
80 lbs. sulphate potash.  
320 lbs. acid phosphate.

{ 500 lbs. cotton seed meal.  
320 lbs. acid phosphate.  
80 lbs. sulphate potash.

{ 320 lbs. acid phosphate  
80 lbs. sulphate potash.

{ 20 bbls. lime.  
320 lbs. acid phosphate.  
80 lbs. sulphate potash.

{ 18.4 tons horse manure.  
320 lbs. acid phosphate.  
80 lbs. sulphate potash.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
22.2 tons cow manure.

{ 22.5 tons horse manure.  
320 lbs. acid phosphate.  
80 lbs. sulphate potash.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
22.2 tons cow manure.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
22.2 tons cow manure.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
22.2 tons cow manure.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
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320 lbs. acid phosphate.  
22.2 tons cow manure.

{ 80 lbs. sulphate potash.  
320 lbs. acid phosphate.  
22.2 tons cow manure.

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The results for 1903 shown in the above table may be summarized as follows:

(1)—Spring and fall sowing afforded practically the same yields, about one ton of hay per acre the first season.

(2)—Nitrate of soda applied at the rate of 80 pounds per acre with the seed in spring failed to increase the yield.

(3)—Six tons of stable manure more than doubled the yield the first season when applied in February to fall sown young alfalfa plants.

(4)—Eighteen tons of stable manure enabled alfalfa to yield 3.4 tons of hay per acre the third season after the application.

(5)—Lime, at the rate of 20 barrels per acre, reduced the yield the third year after application in a crop practically equal to that obtained by the use of 18 tons of stable manure at the same time.

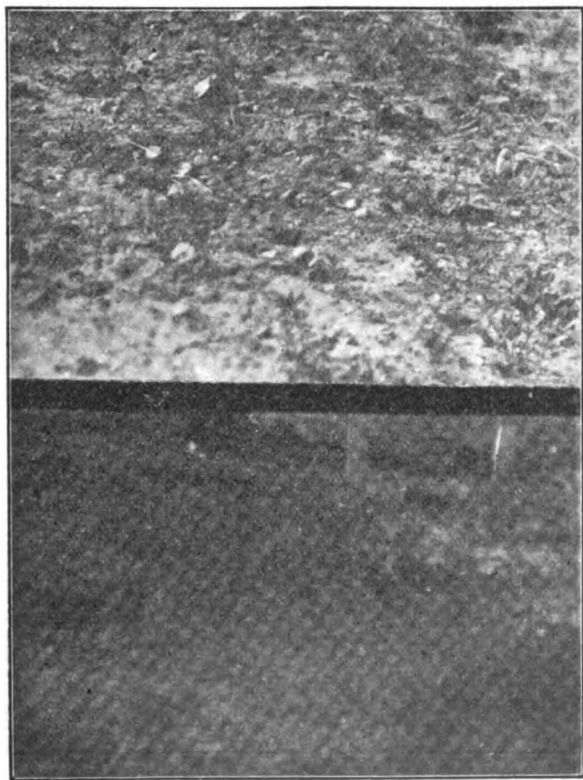
(6)—The application of both lime and large amounts of stable manure together did not increase the yield the third year after application as compared with either applied alone.

The first cutting of hay was nearly pure alfalfa; the second contained considerable crabgrass, and the third cutting contained more crabgrass than alfalfa.

#### EFFECTS OF LIME AND INOCULATION COMBINED.

On October 3, 1902, three plots of sandy soil of poor quality on the Experiment Station farm at Auburn were sown with alfalfa. Phosphate and muriate of potash were used on all plots. Plot 3 had neither lime nor inoculation; plot 4 was not limed, but inoculated as follows: Soil from an old alfalfa field 100 yards distant.

was stirred into water, the seed dipped into this water, and then thirty bushels per acre of the same soil was sown broadcast and harrowed in promptly. Plot 5 was similarly inoculated and 1,000 pounds per acre of slaked lime was applied. Winter killing was severe on all plots, but much more severe on plots 3 and 4 than on the plot which was both limed and inoculated. Figure 1 shows in the lower part that on the plot both limed and inoculated the young plants had covered the ground; few and small were the plants surviving plants on plot 4, as shown in



**Fig. 1.** Below. ground is covered with young plants, which have been inoculated and limed; above, lime omitted, and ground nearly bare.

the upper part of Figure 1. Figure 2 shows the plants taken in April from each plot. Note the absence of tubercles on the plants from the plot that was both limed and inoculated. The liming and inoculation seemed to make the young plants hardier and more resistant to cold. No one of these plots was a success, being left at the end of winter only about half a stand on plot 5, and much less on the other two plots. The yield for the season was 2,266 pounds per acre where liming and inoculation had been employed, while on the other plots there was not enough hay to be raked.

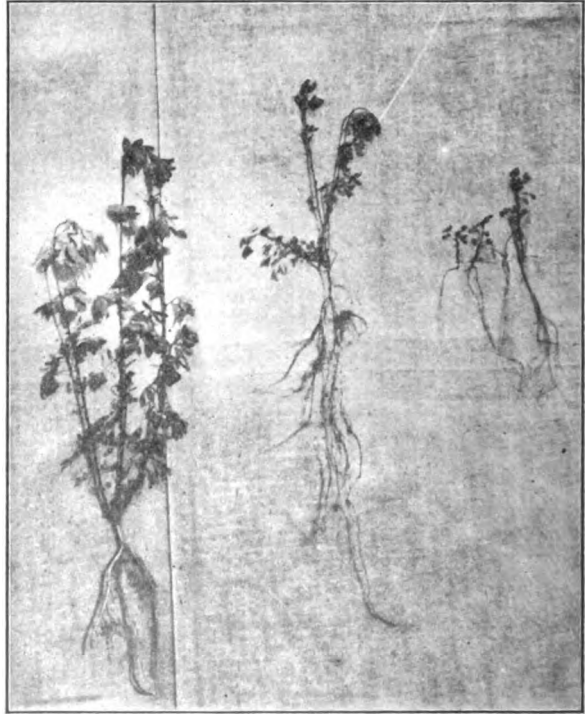


Fig. 2. Small plants **not** inocuated; central plant, not limed, **best** plant, inoculated and limed.

An adjacent plot was sown in crimson clover at the same time that the alfalfa was sown, and after the cutting of the crimson clover, the same plot was sown in June in broadcast sorghum. The yields obtained give an interesting illustration of the fact that under ordinary conditions on sandy land unsuited to alfalfa, other crops often furnish a far larger quantity of forage. The yield of crimson clover on this adjacent plot was 6,100 pounds per acre, and the amount of sorghum hay obtained at one cutting during the same season was 13,000 pounds per acre. These are exceptionally good yields of both crimson clover and sorghum. This is an extreme case where all conditions were highly favorable for crimson clover and sorghum, and exceedingly unfavorable for alfalfa.

#### FERTILIZER EXPERIMENTS ON PRAIRIE LAND.

A series of fertilizer experiments on 10 plots was begun in 1902 in co-operation with Mr. J. O. Hays, Sumter county, Ala., by whom the fertilizers were applied in accordance with the writer's plan. The seed were not sown until April 3, only a few weeks before the beginning of the memorable drought. In the absence of any considerable amount of rain until August 28, the fertilizers were without effect. No hay was raked, but Mr. Hays reports that this alfalfa, though sown late, "stood the drought better than any other forage plant, and is the only one that kept a good lively green color, while Bermuda grass was parched perfectly yellow, and sorghum was twisted and stopped growing."

It should be added that eight of the plots were inoculated with soil from an old alfalfa field.

In 1903 Mr. Hays again undertook a fertilizer experiment for this station. On June 13 he writes: "Plots 9 and 10, the ones most highly fertilized, are the best."

These both received per acre 200 pounds cotton meal, 240 pounds acid phosphate, and respectively 100 pounds of kainit.

#### MANURE.

For the prairie region it may be said that no fertilizer except stable manure has yet been sufficiently tested on alfalfa to determine its suitability. In numerous instances stable manure has greatly increased the yield of alfalfa on prairie lands, and the most experienced growers of alfalfa use it so far as the limited supply permits. The benefit from the use of stable manure is a common experience in west Alabama, and the application of manure has immensely increased the yield of alfalfa on the lime land of Mr. J. A. Dillard near Montgomery, Ala. The writer can testify from a personal inspection.

However, the question may well be raised whether alfalfa is the best crop on which to apply stable manure, which is so scarce and so sure to largely increase the yield of any crop. So far as concerns the nitrogen of stable manure, alfalfa could well dispense with it. For alfalfa thoroughly inoculated and on land sufficiently well drained to insure fair soil ventilation, should be able to obtain through its root tubercles unlimited quantities of nitrogen from the air. On the other hand, sorghum or cotton, not having this means of securing nitrogen, would make good use of the nitrogen as well as of the other constituents of stable manure. In the case of the application of manure to alfalfa is the fact that this application in winter promotes early development of the plants, and forces the alfalfa to a sufficient height for cutting at a time when other forage is scarce. Moreover, if immense quantities of stable manure are used, it will serve as a mulch, retaining the moisture in the soil.

and alleviating the effects of drought. On the other hand, surface application of manure without incorporation with the soil results in great loss of the valuable portions of the manure and is ordinarily a wasteful method of application.

#### INOCULATION.

Alfalfa belongs to that family of plants able to derive a large part of their nitrogen from the gaseous nitrogen of the air. This is done through the agency of enlargements on the roots, called tubercles or nodules. Within these tubercles dwell countless numbers of microscopic vegetable organisms, usually referred to as nitrogen-fixing bacteria or germs.

Root tubercles of alfalfa, clovers, vetches, cowpeas, velvet beans, and other legumes, are essentially fertilizer factories engaged in the manufacture of nitrogen. This is a fertilizer material, which, when bought in the form of cotton seed meal or nitrate of soda or ammoniated guano, costs about 15 cents per pound. The importance of the work of root tubercles may be realized from the fact that a crop of any one of these plants growing on an acre usually contains from 75 to 200 pounds of nitrogen in roots and tops taken together.

When the germs necessary for causing tubercles to develop on the roots of alfalfa are absent from the soil and from the seed, the roots of alfalfa have no tubercles. The proper germs, which we may designate as alfalfa germs, are usually absent from the sandy and non-calcareous soils of Alabama, and often from other soils. More frequently there are a few of the proper germs present either in the seed sown or in the soil, so that tubercles develop on a small proportion of the plants.

A leguminous plant without tubercles is a drone



that no farmer can afford to provide for. Such plants depend entirely upon fertilizers for their extra nitrogen or draw it from the earth, thus impoverishing the soil.

The farmer has it in his power to cause tubercles to develop on the roots of his alfalfa, and thus to force plants to provide their own nitrogenous food, and to enrich the land in nitrogen. When leguminous plants form their tubercles without aid from man we speak of the process as natural inoculation. Experiments on a number of soils at Auburn and observations of young alfalfa plants in a number of other localities lead us to conclude that the alfalfa germ is wanting, not present in sufficient numbers in most of the sandy and clay soils of Alabama that are deficient in lime. On such soils the necessary germs must be supplied by the process of inoculation, or more accurately, by artificial inoculation.

The material used for inoculating alfalfa may be taken from a field where alfalfa or bur clover (a plant of the same genus) has in recent years been well supplied with root tubercles, or it may be a concentrated prepared material now being manufactured in the laboratories of the United States Department of Agriculture.

To inoculate with soil we have used the following methods, depending on convenience and on the amount of inoculating soil available.

(1) With small amounts of inoculating soil: take about a peck of soil from an old alfalfa or bur clover field add several gallons of water; stir well; allow a few minutes for settling and then moisten every alfalfa seed thoroughly with the muddy water, which contains the necessary germs. Then dry the seed by mixing with them more of the same inoculating earth in a loose condition and crushed as fine as possible. Cover promptly.

(2.) With large amounts of inoculating earth: Moisten the seed as above; dry as above, if convenient; sow broadcast per acre 20 to 30 bushels of the same earth in as fine a condition as possible, and harrow in seed and inoculating earth as promptly as possible. The method of inoculation and the amount of inoculating soil can be varied according to convenience.

Directions for use accompany the pure cultures sent from Washington. Dr. A. F. Woods, under whose direction this inoculating material is distributed, authorizes me to state that the Department will supply free inoculating material for alfalfa to any parties whose names I shall send in, and who will furnish their own seed. Applicants should state the number of acres that they will plant.

On prairie soil the writer has repeatedly observed that alfalfa plants are, when young, well stocked with tubercles. The cause for this is evident from the recent investigation of Dr. C. G. Hopkins, of the Illinois Experiment Station. Under date of February 2, 1904, he writes as follows with reference to his bulletin now in press, and gives permission for this use of his results: "The investigations reported in this bulletin prove conclusively that the bacteria of sweet clover are similar to the bacteria of alfalfa."

#### RESULTS OF INOCULATION OF ALFALFA ON SANDY LAND.

In an inoculation experiment with alfalfa made by the writer in February, 1897, the yield of alfalfa at the first cutting was increased 336 per cent as the result of inoculation. The soil within the plots was from a sandy field near Auburn, and the inoculating material was the dust sifted out of bur clover seed and derived from the soil on which bur clover had grown. In several later

field experiments the use of bur clover earth has reduced tubercles and greatly increased the yield of alfalfa.

Figure 2 shows typical alfalfa plants taken in August 1903, from three plots at Auburn, sown the preceding October. The small plants on the right had been neither limed nor inoculated and were free from tubercles; the plants in the center had been inoculated, but not limed; the largest plant had been inoculated and limed, and the supply of tubercles is abundant. Soil from an alfalfa field was used in this experiment as inoculum material.

#### INOCULATION OF ALFALFA ON PRAIRIE SOILS.

In the light of Dr. Hopkins' demonstration we can now see why it is unnecessary to inoculate alfalfa on fields where melilotus (sweet clover) has recently grown, and produced tubercles, for it almost invariably does on prairie soil. It would still seem advisable, however, to inoculate alfalfa seed to be sown on such prairie land as has not recently grown melilotus. While these germs have probably been widely distributed by wind and water, otherwise, in the prairie region, we have no proof that they are present in all fields of prairie land in sufficient numbers for *best* immediate results with alfalfa.

Indeed the observation made by Mr. J. O. Haynes in our fertilizer experiment on gray prairie land in Grant county, previously referred to, seems to indicate that there is an advantage, at least during the first few months of growth, in inoculating alfalfa on some prairie land. In 1902, on land which had been used as a pasture for a number of years, he reports that on the first few months-old inoculated alfalfa plants tubercles

abundant, while up to that time none had been found on the plots not inoculated.

Relative to a similar experiment in 1903, he writes under date of June 13, 1903, as follows: "I inoculated all plots except No. 8, which seems to be the poorest of any of them."

In view of Dr. Hopkins' conclusions, we can now recommend that earth from an old melilotus field be used for inoculating alfalfa, where this is decidedly more convenient than to use earth from alfalfa or bur clover fields or than the pure culture of the laboratory.

#### TIME TO SOW.

The following is a summary of results of sowing alfalfa on the station farm during the eight years that work has been under the writer's charge:

We have records of fall sowings on ten different dates. In every case when alfalfa was sown broadcast after November 1, the stand was ruined by cold. In one case alfalfa sown as early as October 7, (1901), was almost completely winter killed. Plants from seed sown as early as September 13 (1900), and as late as October 29 (1899) survived the winter, although in other years a considerable proportion of the sowings made in late October resulted disastrously.

We have records of eight dates of spring sowing of alfalfa on the station farm. These point to the first half of March as better than a later date.

In our co-operative experiments with alfalfa in 1903-1904, arranged for in nearly every county in the State, fall sowing was made unduly late by drought, and cold weather came on unusually early, and has been unusually continuous. Moreover, in most cases there was insufficient moisture to cause the young plants to grow

rapidly. Under these conditions, it is estimated reports thus far received that in considerably more than half the experiments the stand of alfalfa was well established. These reports afford an interesting comparison of the relative hardiness towards cold of the young of alfalfa, crimson clover and hairy vetch. The first two, when very young, are almost equally sensitive to cold, while hairy vetch is much hardier in this respect than either.

Alfalfa has been successfully sown in Alabama in the early fall and in the early spring. The principal advantages of fall sowing are the following:

- (1.) A larger yield of hay obtainable the first summer;
- (2.) Less danger of having the alfalfa overtopped and crowded out by crab grass and weeds;
- (3.) Use of teams in preparation for alfalfa in August and September, when they would not be employed in preparing for the usual crops.

The chief advantages of spring sowing are as follows:

- (1.) Freedom from risk of winter killing, to which fall sown alfalfa, especially that sown late, is liable;
- (2.) Opportunity to sow alfalfa after cotton, the best of the hoed crops to precede it;
- (3.) Usual better condition of the land for plowing in December and January than in August and September.

Each reader must contract these opposing advantages in the light of his own conditions. By far the greater proportion of alfalfa sown in Alabama on prairie is put in after Christmas, which suggests that the

generally the most convenient time. Some years it is the only practicable time, the ground being too dry and hard in the early fall. Several extensive growers of alfalfa who sow chiefly in the spring, nevertheless express preference for fall sowing when there is sufficient moisture for thorough preparation and for sowing *early* in the fall.

Fall sowing should occur at a date early enough to permit the roots to penetrate deeply before freezes begin, and thus to anchor the plants against heaving. Not only are young alfalfa plants easily heaved or lifted out of the soil by alternate freezes and thaws, but the very young plants are otherwise and more directly injured by severe cold following mild weather.

In Central Alabama we would recommend that fall sowing be done, if practicable, from September 15 to October 15, with the preference for the earlier part of this period. While a date as late as November 1 occasionally gives success, the risk of winter killing is then too great. If alfalfa cannot be sown before October 15 in central Alabama, we would recommend that sowing be postponed until March.

The safest period for spring sowing is from March 1 to 20. Some sow on prairie land as early as February, but from February sowing at least one instance of loss of stand from cold has come under our notice. While seed sown in April sometimes succeed, the success is less uniform than with March sowing. The more needy the land the stronger the reason for fall sowing.

#### PREPARATION.

There is no field crop that pays better for thorough preparation than alfalfa. The man who is content to prepare land for alfalfa as he would for oats had best

leave this crop to some one else. The plowing of alfalfa should be deep and thorough and it is highly probable that subsoiling on prairie and other sterile land would be more profitable for alfalfa than for any other field crop. Harrowing must be done, not once, but two to four or more times, according to the condition of the land. Usually two harrowings with a chain harrow and two with a tooth harrow (including the first given after sowing the seed) will suffice.

Harrowing for fall sowing will be most effective if done within a few hours after plowing. For spring sowing this is less imperative. It is important to keep between the time of plowing and the time of sowing a sufficient interval should elapse for rains to compact and settle the soil. If sufficient rain does not fall to settle the soil, this should be done by repeated use of a heavy weighted drag. One of the most common causes of failure to secure a satisfactory stand in alfalfa consists in having the soil too loose at planting. For fall sowing, plowing should occur at least four or five weeks before the seed are to be sown. If alfalfa is to be sown about the first of March the plowing should be done in November or December, or January, more profitable than just before planting. Land plowed before Christmas will only need to have the surface freshened with the harrow at the time of sowing. While the above statements embody the general experience, success sometimes attends the sowing of seed immediately after plowing. A farmer in the eastern part of Texas who has many hundred acres of alfalfa, describes his method of preparation of prairie for alfalfa as follows: "I use a disc plow with four good mules, run a subsoil plow drawn by four mules eighteen inches deep behind the disc. I then follow with a disc harrow with four mules, then

the land with an implement eight or nine feet long and five feet wide, made by 2x6's spiked together; six mules draw this. I can reverse the float, turn it over and use it to level the land in rough places. I am not yet ready to seed this land prepared in this way. I must have a rain on it that will settle it and take the air cells out. Then, with a light toothed harrow I break the surface, sow the seed with a wheelbarrow seeder and cover with a light harrow followed by a heavy steel roller. Good black land seeded in this way will return \$40 or \$50 per acre every year, at very little cost for labor."

One grower in West Alabama subsoiled his land for alfalfa last fall, but it is too early for the effects of subsoiling to become apparent.. One grower in the same neighborhood harrowed his land seven times, an extreme case. Others report satisfaction from one or two harrowings, a number often insufficient. It should be borne in mind that preparation for alfalfa is expected to suffice for from three to twenty years, and should therefore be thorough.

#### SOWING BROADCAST VERSUS IN WIDE DRILLS.

It is maintained by some parties that in the Gulf States drilling alfalfa, with such distance between rows as to permit of cultivation, will be more satisfactory than broadcast planting. In three experiments at Auburn and in one at Uniontown, drilling was unsatisfactory. On the station farm at Auburn it was found difficult in planting by hand in drills to avoid covering the seed too deep, and it was found that the amount of cultivation required to keep the grass and weeds subdued in drilled alfalfa was greater than it is practicable to give to a hay field.

On the Canebrake experiment farm at Uniontown,



where the drills were about 24 inches apart and no cultivation given, crab grass and weeds crowded the alfalfa more than in the portion of the field sown and cast.

However, for a small patch of alfalfa kept for hay, drilling and cultivation may be necessary and feasible, especially on highly fertilized sand land filled with the seeds of crab grass and weeds. Planting in very narrow drills by the use of grain drills is the favorite method in alfalfa-growing states. The ordinary course does not permit of cultivation.

#### SOWING.

Most of the successful growers of alfalfa in Alabama have used about 20 pounds of seed per acre, and this is the amount that has invariably been used on the best farm at Auburn. Capt. John C. Webb uses 40 pounds. The excellent stand obtained in 1903 at the Canaan station resulted from sowing a little more than 20 pounds per acre. One grower in Alabama reports the use of 30 pounds, or half a bushel of seed. Yet the best grower is one who most emphasizes the presence of large amounts of crab grass and fox tail grass, indicating that sowing large amounts of seed is not always advisable in crowding out weeds, though it has that tendency.

If ten or more acres are to be sown, it is best to use one of the ordinary patterns of seed sowers instead of sowing by hand. The Cañon is the one used at the station, and this seems to be in most general use in the State. One grower makes use of the seed attachment on the disc grain drill, a method which is common and satisfactory in states where this machine is in general use. When alfalfa seed are sown by hand, the most even distribution is obtained by dividing the seed into two parts and going over the land twice.

In Alabama alfalfa should be sown alone and not with grain, which is so much used as a nurse crop for alfalfa, clover and grasses in the North and West.

In covering alfalfa the procedure must necessarily differ according to local conditions, the preparation of the land, and the state of the weather. The most common custom in Alabama is to cover with a spike tooth harrow, teeth inclined backward. An equally good or better way employed by a few growers is to cover the seed with a weeder, which affords a more shallow covering than any form of harrow. A carefully made brush drag can also be used, but either of the preceding implements is preferable. We have found it advantageous when the land is dry to use the roller immediately after sowing and then to use the harrow or weeder. This order could be reversed, but at the risk of having the rolled surface transformed into a dense crust, should a heavy rain fall occur before the seed germinate. Cornburn, an authority on alfalfa, advises that when from any cause a crust has been formed prior to the appearance of young plants, that this crust should be broken with weeder or harrow, even at the risk of bringing some of the sprouting seed to the surface.

It pays to buy the best alfalfa seed, even though they should cost several cents more than inferior seed. Imported as well as old should be avoided. So far as this information can be obtained, it is desirable to purchase seed grown in regions where love vine (dodder) is not abundant. In any case it is advisable to buy seed that have been run through a machine that is claimed to be able to remove the seed of dodder. As indicating the need of buying the best alfalfa seed, even at an increased price, one of the farmers who is conducting one of our alfalfa experiments in Wilcox county, under the

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writer's direction, reports as follows, under date January 23, 1904: "All the seed sent from Washington came up readily to a good stand. \* \* \* The seed bought did not make a 15 per cent. stand."

To test the germinating power of alfalfa, dampen small pieces of cloth; place 100 seed between the pieces of cloth. Then put the whole thing in a plate or saucer, cover it, and leave it in a warm room, repeating the moistening the cloth before it dries. Count the seed that sprout within ten days.

#### BEST CROPS TO PRECEDE ALFALFA.

A crop selected to get land in best condition for alfalfa should be one that either leaves the land clean and unusually free from weeds and weed seed, or that adds vegetable matter, and hence enriches the soil. Cotton fulfills the first requirement, and cow peas or melilotus the second. The land that is to be sown to alfalfa next fall should be sown thickly in a round variety of cow peas in May, 1 1-2 to 2 bushels per acre. The vines should be cured for hay about a month or more before the time for planting alfalfa. On soils deficient in vegetable matter it may be profitable to plow under the entire growth of cow peas. If the latter plan is followed, this mass of material should be plowed under in ample time for rotting to occur, or from 40 to 60 days before the date of planting. When green manure is plowed under at this season it is desirable to compact the soil with the roller or heavy drag, otherwise this vegetable matter before rotting will injure the soil by dry out the soil by preventing the rise of capillary moisture from the moist subsoil. On soils deficient in lime the lime necessary for alfalfa can be applied

the green growth of cow peas is turned under, thus hastening rotting and obviating the souring effect that might otherwise occur. Melilotus furnishes vegetable matter and nitrogen for alfalfa, and also by means of the decay of its large and deeply penetrating roots assists in the drainage of prairie soils. It is advisable to let the carefully worked cotton crop, intervene between the turning under of the second years' growth of melilotus and the sowing of alfalfa seed. This interval permits the owner to free the land from any volunteer plants of melilotus and from weeds.

#### JOHNSON GRASS LAND FOR ALFALFA.

One of the important advantages of alfalfa is its ability to grow in land too thickly set with Johnson grass for the profitable cultivation of corn or even of cotton. By the introduction of alfalfa or hairy vetch into a Johnson grass meadow, the soil will be to some extent enriched in nitrogen, the nutritive quality of the hay improved, and the total yield of hay increased.

An effort was made by correspondence with leading growers, to learn whether the successful growth of alfalfa in Johnson grass meadows was conditional upon such preparation of the land as would kill a large part of the Johnson grass. The general experience is that alfalfa thrives in old Johnson grass meadows even when the preparation for alfalfa is such as would ordinarily improve the growth of Johnson grass. The verdict was almost unanimous that Johnson grass did not crowd out the alfalfa in the second or third year after the alfalfa was sown. Those with the longest experience were as emphatic as others in stating that alfalfa was quite equal to a contest with Johnson grass, and some growers even stated that the alfalfa was tending

to crowd out the Johnson grass. When alfalfa is in land stocked with Johnson grass, fall sowing the alfalfa an advantage over its competitor. further means of giving the ascendancy to alfalfa consists in breaking the Johnson grass land and thickly with cow peas, cutting the cow peas and Johnson grass for hay, and turning under the stubble a month or more before sowing alfalfa seed.

#### PRINCIPAL ENEMIES OF ALFALFA.

Among these first rank must be given weeds and weedy grasses, chief among which is crab grass. The presence of tubercles have been responsible for the majority of failures that have come under the observation. Other weeds that have given trouble to alfalfa on the station farm are evening primrose, morning glories, pepper grass, and even lespedeza or Japanese clover. Among weeds most troublesome in prairie regions are crab grass, Bermuda grass, *Sida spinosa*, (a rather branched weed with small yellow flowers and narrow leaves), morning glories, fox tail grass, prairie dog grass, horse nettle, and cow itch vines.

The only method known for decreasing injury from weeds is one of prevention rather than cure. Injury from weeds is best prevented by growing alfalfa before alfalfa, cotton or some other crop requiring careful cultivation. The avoidance of manure made from feeding hay abounding in weed seeds is also advised. Manure from cattle fed on cotton seed meal and alfalfa is the best kind for alfalfa. Fall sowing is one of the best means of enabling alfalfa to get a start and gain a triumph over its many enemies among the weeds. The judicious use of the disc harrow and even the use of a weeder when crab grass has just appeared is sometimes helpful.

Dodder, which is often introduced in alfalfa seed, is a thread-like, yellow vine, feeding on and destroying alfalfa. Mowing and burning in place is the most convenient of several remedies.

The most successful method of combatting weeds consists in frequent mowing during the first year, even when the alfalfa plants have not attained sufficient height for hay making. Repeated clipping with the mower during the first summer will do much to repress weeds and to thicken the stand of alfalfa by making the plants throw out a greater number of stems.

Leaf rust on alfalfa, appearing in the form of small black spots on the leaves, has been very destructive to alfalfa on the station farm, especially during damp weather. When it becomes serious, the best thing to do is to mow the alfalfa, the new growth usually escaping injury for quite a while.

A more fatal disease occurring on alfalfa on the station farm is a sclerotial root disease, which, however, the writer has not observed in other alfalfa fields. Indeed this root disease has been the principal cause of failure of our most promising fields of alfalfa, a large proportion of the plants in certain fields being killed by it.

#### CLIPPING AND DISCING ALFALFA.

After the young plants appear the most effective aid that can be given them is to use the mower frequently. Clip young alfalfa whenever weeds crowd it, and whenever it rusts or turns yellow from any cause. If the growth is slight, leave the mown material on the ground as a mulch and fertilizer, provided it is of a kind that will not give trouble when hay is raked after a later cutting.

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Old alfalfa, whose growth has been arrested, and which has become unthrifty, is often benefited by prompt mowing, even though the growth be too light for harvesting.

The next most important treatment usually recommended for alfalfa more than a year old is to run a harrow over it when needed. This is sometimes done after each cutting, but judgment is needed in this matter. The discs are set straight so as not to cut off the plants. Discing serves as a cultivation and to thicken the stand of old alfalfa. On sandy land at Auburn we have found a weeder useful in young alfalfa in killing very young grass and weeds just germinated.

At Auburn crimson clover sown early in October with old drilled alfalfa was ready for cutting at the same time as the alfalfa, and the combined yield was large. This combination is not advised except when the stand of alfalfa has become so thin that it is about time for it to be plowed under.

#### TOLERANCE OF ALFALFA TOWARD OVERFLOWS.

When excessive rains occur and poorly drained lands remain saturated for a long time, alfalfa sometimes takes on a pale yellowish, sickly color. This plant is classed as among those least able to endure prolonged saturation of the soil. Yet the large yields obtained on bottom lands make it worth while to take some chance of injury from overflows, especially on soils so drained naturally or artificially that the ground soon dries after the waters subside.

An overflow does not necessarily mean the destruction of the alfalfa plants. Experience in other states indicates that alfalfa may pass safely through a submer-

ence of several days if all conditions are favorable. Its endurance of overflow is greater when the water is moving than when it is stagnant, and greater during the cooler periods of the year than when the plant is in a more active stage of growth. The deposit of much sediment on the plant, and hot, fair weather immediately after the water passes off are conditions unfavorable to recovery. Rains, washing off the sediment, are favorable to recovery.

In a bulletin of the Texas Experiment Station are cited two instances in which alfalfa in the Brazos River bottoms was under water for five or six days in summer without the destruction of the stand, except where the deposit of sediment was great or on poorly drained areas. These are extreme cases, and refer to soil that was well drained. Mr. R. P. McEntire, of Decatur, Ala., gives his experience with overflow as follows: "In the fall of 1901 I sowed 3 acres October 15, and got a good stand. In January we had an overflow from the Tennessee River, which was out over the land for two weeks. In a few days we had a hard freeze. Then on February 15 we had another overflow, which lasted 10 days. As the water went off we had another freeze. When spring opened I had something like half a stand." It would seem that one might raise alfalfa on land naturally well drained and where the overflows occur chiefly in winter, and where it is unusual for the water to remain on the land as long as three or four days in winter or two days in the warmer part of the year.



## HARVESTING ALFALFA.

A discussion of the methods of harvesting alfalfa and of the machinery and devices employed would unduly tend this bulletin. In brief, alfalfa should be cured in the shortest practicable exposure in the swarth to the sun. The leaves are the richest portion of alfalfa, and if the hay is sunned too long the leaves drop off. The preferred time for cutting alfalfa is when about one-third in bloom, but this varies with the weather and with the thrift of the plants.

## SUMMARY.

Alfalfa is a perennial leguminous plant, useful for hay, feeding green, pasturage, and for soil improvement. In nutritive qualities alfalfa stands in the first rank, and when fed to farm teams the ration of other feed can be greatly diminished. On suitable soil the yield of hay exceeds that of any other hay plant. On prairie soils in Alabama yields of more than 3 tons per acre have been obtained in two instances within seven months after sowing the seed, and the yield continues to increase for several years. Farmers report 3 to 5 tons per acre as the usual yield of hay per acre on prairie soil in Alabama, and in a number of instances these yields have greatly exceeded.

Alfalfa makes an unrivaled hog pasture, and is recommended as a pasture plant for horses and mules. Cattle and sheep sometimes bloat when grazing

alfalfa. Pasturing, especially during the first year, injures and sometimes kills alfalfa.

Soils for alfalfa should be rich, well drained, well supplied with lime and vegetable matter. Alfalfa has been repeatedly demonstrated to be a success on the best grades of prairie soil on both uplands and lowlands. There is reason to believe that alfalfa will thrive on the same soils of the Tennessee Valley region and on other calcareous soil in Alabama, and on fertile, well drained, alluvial soils in nearly every part of the State.

A crop of 4 tons of alfalfa hay contains 176 pounds of nitrogen, 40.8 pounds of phosphoric acid (equal to that in 336 pounds of high grade acid phosphate), 134.4 pounds of potash (equal to that in 1,075 pounds of kainit, or in 269 pounds of muriate of potash, and 280 pounds of lime. To replace only the phosphoric acid and potassium commercial fertilizers an expenditure of about \$8.75 would be required.

The preparation of the land for alfalfa should be thorough, including plowing as deep as practicable, and repeated use of disc and spike tooth harrow. Generally it is best to plow a number of weeks before the seed are to be sown. A weeder or light harrow is the preferred mode of covering the seed, which are sown broadcast at the rate of 20 pounds or more per acre. Fall planting before October 15, when practicable, gives alfalfa a start ahead of weeds, but spring planting (early in March), is usually more convenient.

Alfalfa, especially that sown in the spring, requires and as free as possible from seeds of weeds, crab grass, etc. Repeated use of the mower during the first year is the preferred method of combatting weeds in alfalfa.

Planting alfalfa in drills and cultivating it may be

suitable for a small patch kept for feeding green, but this system was found impracticable for a hay field.

Usually the best crop to precede spring sown alfalfa is cotton, especially if cotton follows melilotus (clover). The best crop to prepare the land for fall sown alfalfa is cow peas, sown very thick.

Numbers of farmers have found that alfalfa grows well when sown on Johnson grass meadows, holding it off for at least for the first few years, against this aggressive grass.

Dodder, a yellow thread-like growth, is a serious enemy of alfalfa. One of the remedies consists in pulling and burning. Seed merchants often pass alfalfa seed through a machine which is claimed to remove the dodder seed.

On sandy upland soils at Auburn alfalfa has not afforded very profitable yields. On such soils it requires heavy applications of lime or barnyard manure, and it is believed that more profitable use can be made of the manure. At Auburn neither nitrate of soda nor cottonseed meal very greatly increase the yield of alfalfa though properly stocked with root tubercles. Acid phosphate and potash fertilizers are considered indispensable and generally advisable on sandy or other soils not rich in lime.

Inoculation with soil from old fields of either alfalfa or bur clover greatly increase the yield of alfalfa sown on sandy land.

The germ that causes tubercles to develop on alfalfa clover (melilotus) also causes tubercles to develop on the roots of alfalfa. Hence artificial inoculation of alfalfa is not necessary when it is grown on prairie land that has recently borne a crop of melilotus. An

ulation of alfalfa is probably advisable even for  
irre soils when it is uncertain whether either the me-  
tus or alfalfa germs are present in great numbers.  
n regions in Alabama where neither alfalfa, melilo-  
nor bur clover is extensively grown, inoculation of  
alfa is advisable. For this purpose one may use soil  
n old fields of either of these plants or inoculating  
erial prepared in the laboratory.

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**ALABAMA.**

# **Agricultural Experiment Station**

OF THE

**Alabama Polytechnic Institute.**

**AUBURN.**

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## **Feeding and Grazing Experiments with Beef Cattle.**

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By

**J. F. DUGGAR, Director and Agriculturist.**

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# FEEDING AND GRAZING EXPERIMENTS WITH BEEF CATTLE.

By J. F. DUGGAR, R. W. CLARKE, and JESSE M. JONES.\*

## *Summary.*

Using twenty young grade steers of the beef breeds, the following comparisons of foods were made: Cotton seed with cotton seed meal (Lots II and I); sorghum hay with a mixture of cowpea and sorghum hay, (Lots III and II); sorghum hay with shredded corn stover (Lots III and IV).

The feeding period covered 84 days, in addition to preliminary feeding. In all rations a small proportion of corn chop was used. As much grain was fed as the appetites and health of the steers permitted. As much roughness was fed as the steers would eat.

The average daily gain per steer was as follows:

With cotton seed and cotton seed meal.....2.23 lbs.

With cotton seed and mixed cowpea and sorg-

hum hay .....1.93 lbs.

With cotton seed and sorghum hay.....1.19 lbs.

With cotton seed and shredded corn stover.... .98 lbs.

\*R. W. Clark was Assistant in Animal Industry from September, 1899, to January, 1903, when he was promoted to a professorship in the Utah A. & M. College. Jesse M. Jones occupied the same position from January, 1903, to April, 1904, when he resigned to engage in farming in Alabama. These gentlemen had immediate charge of the experiments during the periods indicated. The Director is responsible for the plans of the experiments and the preparation of this Bulletin.



To produce one pound of increase in live weight was required of concentrated food, "grain," with cotton seed meal rations and sorghum hay, 4.82 lbs.; with the mixed hay and cotton seed ration, 5.41 lbs.; with sorghum hay and cotton seed ration, 8.12 lbs.; with corn stover and cotton seed ration, 9.41 lbs.

The amounts of roughness required to produce one pound of gain were, respectively, 6.56, 6.85, 11.10, 10.23 pounds. The cotton seed meal ration afforded the largest per cent. of dressed meat.

A decline in the price of cattle while the experiment was in progress reduced the margin between the purchase and selling prices to less than six-tenths of a pound, a margin usually too narrow for profitable fattening. On the basis of the very high prices of food prevailing in the winter of 1903-4, there was with cotton seed lots a profit during the first 56 days of the experiment, but a loss after this time with all lots if account be taken of the manure.

On the basis of moderate prices of feed, Lot II was at a profit for 84 days. With low prices of food, Lots II, and III afforded a profit, in addition to the margin on the purchase price.

The profit in feeding beef cattle is made, not in producing new growth at less cost per pound than for steers, but in the increased value of the original animal due to fattening. A margin of one cent per pound between purchase price and selling price is desirable.

About 7 pounds of raw cotton seed was fed daily as a ration without injury to the health of the steers.

Account was kept of the cost of food consumed by three grade or crossbred steers. Up to the average age of 24.3 months the average steer consumed \$18.39 of skim milk, grain, hay, and pasturage, of

at the first year's food cost \$10.45, and that of the second year \$7.94. At 24.3 months, the average weight was 57 pounds, worth at 3 cents per pound, \$26.01. The average cost of food per pound of gain up to this age was 12 cents.

In feeding calves rice meal proved decidedly inferior to corn meal. When inferior shredded corn stover was fed to calves, 37 per cent. of it was refused, and when good shredded corn stover was fed freely to steers, 44 per cent. of it was rejected. The waste in feeding coarse timothy hay, slightly moulded, to steers, averaged 20 per cent.

A Jersey calf, kept stabled until 6½ months old, produced 100 pounds of manure (with accompanying bedding) at the rate of 100 pounds per day.

Fourling steers, kept in a barn, averaged a daily production of 20 pounds of manure per day, exclusive of bedding.

Fourling steers on rye pasture alone gained 1.67 lbs. per head.

Grade calves made on pasture alone an average daily gain of .72 of a pound, or 151 pounds per season. Grade steers made an average daily gain of 1.43 lbs. per year, or 307 pounds per season, on native pasturage alone, or 91 pounds of live weight per acre. This was equivalent to a rental of \$2.73 per acre for the land.

A co-operative experiment made on an unimproved upland pasture, in Macon county, Alabama, a study was made of the rate of growth of scrub cattle that received no food, even during winter, subsisting entirely on native pasturage and the winter range, and otherwise managed in the most primitive manner.

During a pasturage season of 7 months the average increase in live weight and percentage of increase as compared with weight in the spring, were as follows:

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Mature cow, nursing calves, 59 lbs., or 8 per cent.  
 Heifers (2 years old, etc.), 172 lbs., or 39 per cent.  
 Yearlings, male and female, 103 lbs., or 38 per cent.  
 Sucking calves, 141 lbs., or 51 per cent.

Young steers and bulls, 149 lbs., or 35 per cent.

Young steers weighed for two pasturage seasons in succession increased in weight 42 per cent. as yearlings and 44 per cent. as two-year-olds.

On the winter range, cattle of all ages became thin, and in the opinion of the writers, it would have been highly profitable for the owner to have supplemented them with hay and other food during the winter.

The principal essentials to the profitable production of beef cattle in Alabama are the use of pure-bred beef breeds, the economical production of hay, especially from the leguminous plants, the substitution of this hay for a part of the grain ration, and an intensive study of the best methods of handling and marketing cattle.

#### FEEDING EXPERIMENT WITH GRADE STEERS

The steers used in this experiment consisted of sixteen head, bought at Starkville, Mississippi; and three head raised on the Station Farm at Auburn. The Mississippi steers were sired by a Shorthorn bull weighing 1700 pounds, and were out of native cows, about one-fourth of the steers showing strong evidence of Shorthorn blood. These steers were between two and three years old when bought. They reached Auburn November 1903. The three steers raised on the Station Farm consisted of a Red Poll grade, an Angus grade, and a cross-bred Holstein-Shorthorn.

From November 5 to November 20 the entire lot of twenty steers subsisted on a pasture where frost had killed most of the grass on October 24. November 20 they were placed on a bare lot and the feeding of grain, (chiefly cotton seed), and sorghum hay was begun. For the first week they received only two pounds of grain per head daily, which was evidently insufficient. This amount was gradually increased. Throughout this time as much sorghum hay was fed as they would eat.

Our experience with these steers confirms conclusions previously drawn that the feeding of grain to animals intended for slaughter the same winter should begin earlier in the fall than is usual or as soon as the pastures begin to fail. November and December are months in which cattle on pasture shrink rapidly, and doubtless a little grain at this time, even while the cattle are on pasture, will avoid this source of loss.

During the entire time of the experiment each lot of cattle received as much forage as it would consume. The kinds of forage fed to each lot are stated below. An effort was made to make each lot of steers consume approximately the same amount of grain or concentrated food. However, this was found impracticable, but the amounts for the different lots were kept as nearly identical as the appetites and health of the animals would permit.

The forage was fed in racks above the grain trough and was not cut, nor was any of it mixed with the grain ration except such as dropped into the grain trough from the rack above.

It is believed that there would have been an advantage in cutting a small part of the hay and mixing it with the grain. Feeding of both grain and hay was done twice a day. Salt was accessible constantly, and twice a day the steers were driven to a pond for water. The water

supply was not satisfactory, and during cold weather steers would not drink sufficient water. The feeding was done under a rough shed covered with boards and staves, and boarded up on the north side. The south side was left open and each lot of steers had at all times a free choice between remaining under shelter or standing in the small lots located on the south side of the feeding pen. The lots were on a steep, dry, sandy and stony side, well drained, and never became deep with water. Even in wet weather the steers seemed to prefer the lot to the shed.

The figures, which are not all on the same scale, represent the steers as they appeared at the end of the experiment.

The steers were charged with all of the forage put out to the rack, and what they failed to eat was used as manure. The amount of this refused material was determined at several times and the average results are shown elsewhere.

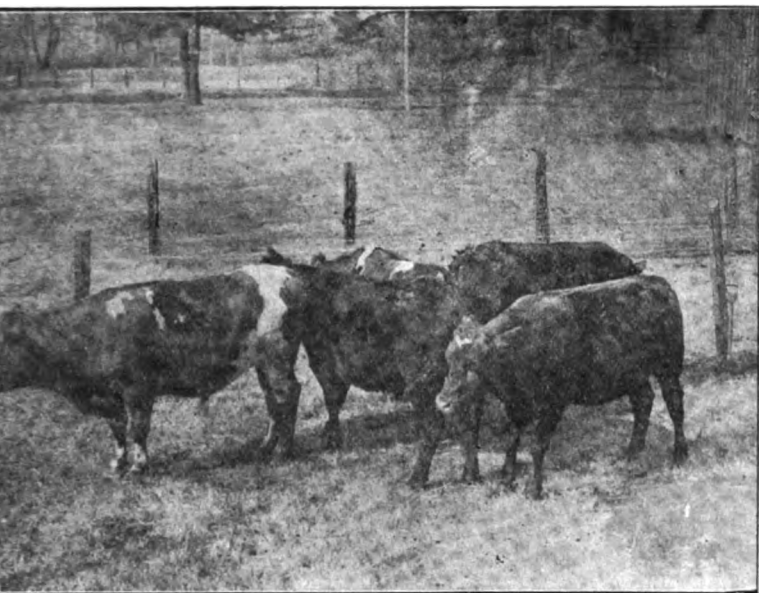
#### RATIONS FED.

The object of this experiment was to compare,

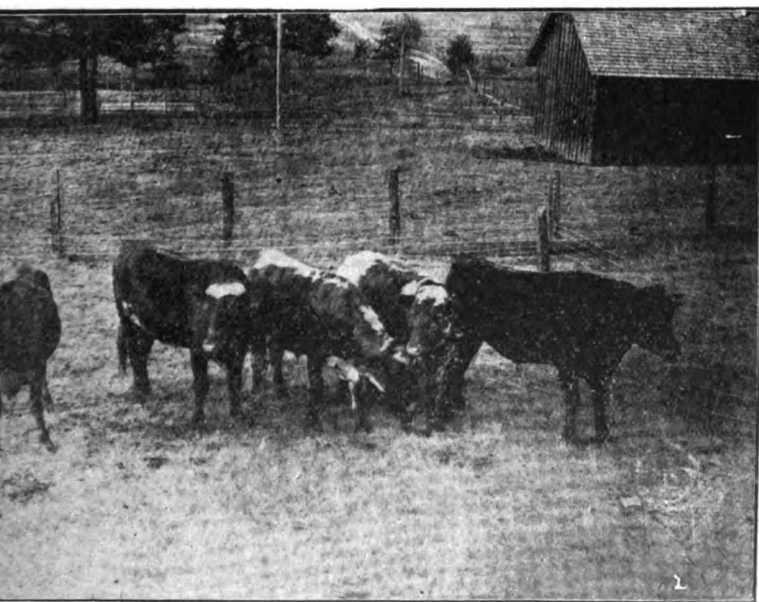
- (1) Cotton seed with cotton seed meal. (Lot III and Lot I.)
- (2) Sorghum hay with a mixture of cowpea hay and sorghum hay. (Lots III and II.)
- (3) Sorghum hay with shredded corn stover. (Lots III and IV.)

All cotton seed was uncooked.

On December 3 the twenty steers were divided into four lots, each containing five steers. In making this division both the weights of the steers and their individual conformation were used as a basis for the division. It is believed that the lots were very much alike in average quality as well as in weight. The weights of Lots I, II, III, and IV on December 9 were respectively, 3878, 3858, and 3889 pounds.

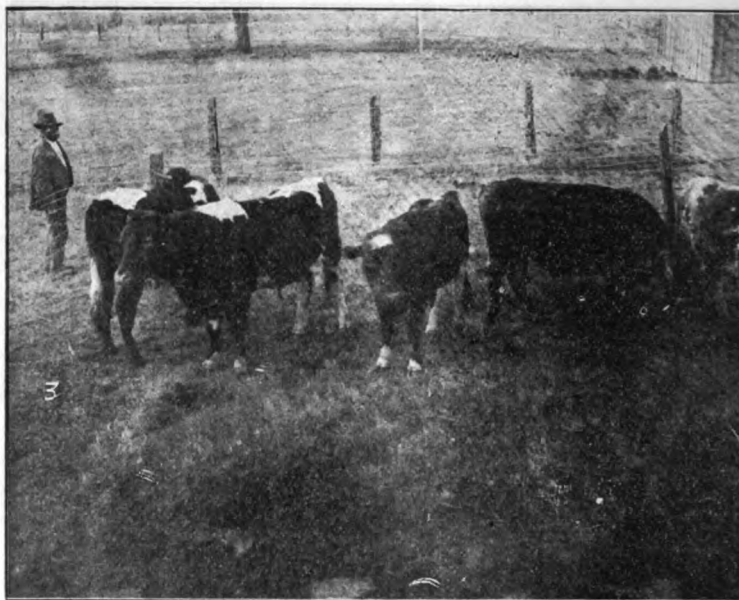


Lot I. Fed cotton seed meal, corn chop, and sorghum hay.

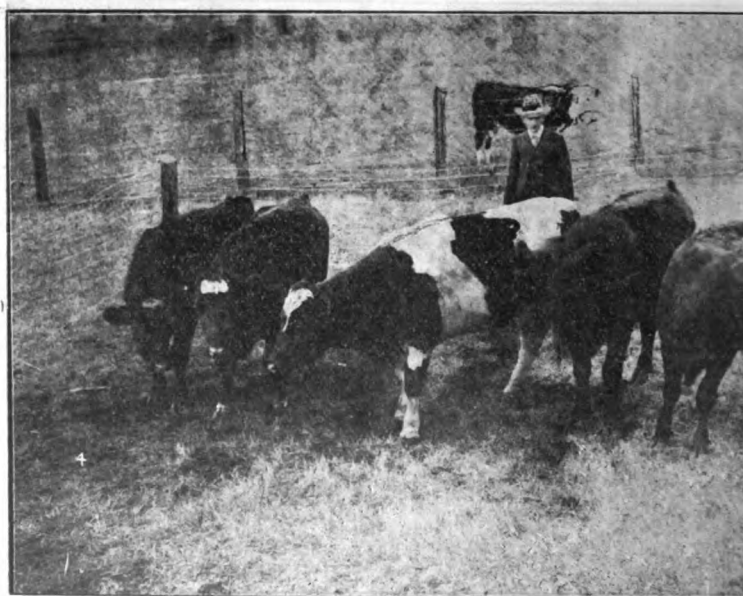


Lot II. Fed cotton seed, corn chop, and a mixture of cowpea and sorghum hay.

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Lot III. Fed cotton seed, corn chop, and sorghum hay



Lot IV. Fed cotton seed, corn chop, and shredded corn stov

The interval from December 3 to December 9 was considered as a preliminary period, and during this time the lot was fed on the kind of food which it was to receive throughout the experiment.

The experiment proper began on December 9, and continued for 84 days, or three periods of 28 days each. During all periods the feed for any given lot was the same in kind and nearly the same in amount, the latter being determined entirely by the health and appetite of the steers.

The weight of each steer was determined at the beginning of the experiment by three weighings made on three successive days. Similarly, the final weight was the average of three daily weighings, March 1, 2, and 3, 1904. The rations fed were as follows:

Lot I—Cotton seed meal, two-thirds; corn chop, one-half; sorghum hay.

Lot II—Cotton seed, three-fourths; corn chop, one-half; sorghum hay, one-half; pea vine hay, one-half.

Lot III—Cotton seed, three-fourths; corn chop, one-half; sorghum hay.

Lot IV—Cotton seed, three-fourths; corn chops, one-half; shredded corn stover.

As much of each kind of forage was fed as the animals would consume without excessive waste. The average amount of forage wasted was as follows:

Lot I—Sorghum, 17.1 per cent.

Lot II—Sorghum and cowpea hay, 20.7 per cent.

Lot III—Sorghum, 23.5 per cent.

Lot IV—Shredded corn stover, 44.2 per cent.

It will thus be seen that the waste of hay was about one-fifth of the amount fed, while the waste of shredded corn was more than double that of hay. This wasted forage, as well as that consumed, was charged against the steers.

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A considerable part of the sorghum hay had passed through a heat in the barn, and was somewhat discolored and slightly moulded. It was all coarse, having been grown in drills and cut after the seed had colored. The cow pea hay, which constituted half of the roughness in Lot II, was not pure cow pea hay, but consisted of cow pea hay, 61.5 per cent.; crab grass, 24.7 per cent.; weeds, 7.8 per cent.; dirt, (sand, etc. raked up in hay), 6 per cent.

The corn stover was bright and of fairly good quality. It had never been baled. The corn chop was coarsely ground to serve the principal purpose for which it was intended, viz., to mix with the cotton seed in order to increase the palatability of the seed. Indeed, the chop was used during the last three weeks of the experiment, but was slightly moulded and not relished, which may partly account for the relatively slow gain made at that time. The foods used were charged at the following prices, which are cost prices for purchased articles, and for home-grown forage a figure somewhat above the cost of production:

Cotton seed, per ton .....	\$14.00
Cotton seed meal, per ton.....	22.00
Corn chop, per ton .....	26.00
Cow pea hay, per ton .....	10.00
Sorghum hay, per ton .....	6.67
Shredded corn stover, per ton....	4.00

The following table gives by periods the average amount of grain and of roughness consumed by the steers in each pen, the average weight per steer at the beginning of each period, the average gain per steer per day and per 28 days, and most important of all, the amount of grain and of roughness required to produce one pound of increase in live weight. It also gives a summary of results for the first two periods (56 days) and for the entire experiment (84 days):

*Average results of feeding experiment with steers,  
1903-04.*

*Period I—Dec. 9-Jan. 6:*

Average daily ration per steer.			Avg. wt. per steer begin- ning	Avg. gain per steer in 28 days	Avg. daily gain per head	Food per lb. of gain.	
Grain.	Rough- ness.	Chief food.				Grain.	Rough- ness.
10.88	.....	C. S. M. & corn	Lbs. 776	Lbs. 83.4	Lbs. 2.97	Lbs. 4.10	Lbs. 5.06
.....	13.3	sorghum.					
10.41	.....	Cotton seed,	783	63.2	2.25	5.15	6.36
.....	12.9	sorg. & pea.					
9.72	.....	Cotton seed,	772	58.2	2.08	4.66	6.15
.....	12.8	sorghum.					
9.46	.....	Cotton seed,	778	55.0	1.96	4.81	4.71
.....	9.3	stover.					

*Period II—Jan. 6-Feb. 3:*

11.2	.....	C. S. M.	859	65.4	2.20	4.79	6.38
.....	14.8	sorghum.					
10.4	.....	Cotton seed	846	66.4	2.38	4.37	5.45
.....	12.9	sorg. and pea.					
10.1	.....	C. Seed.	830	25.6	.91	10.99	14.14
.....	12.9	sorghum.					
9.3	.....	C. Seed	833	14.6	.52	17.91	18.90
.....	9.9	stover.					

*Periods I-II—56 days:*

11.	.....	C. S. Meal	.....	148.8	2.51	4.25	5.45
.....	14.	sorghum.					
10.4	.....	C. seed,	.....	129.6	2.31	4.49	5.57
.....	12.9	sorg. and peas					
9.91	.....	C. seed,	.....	83.8	1.50	6.60	8.59
.....	12.9	sorghum.					
9.38	.....	C. seed,	.....	69.6	1.24	7.57	7.68
.....	9.6	corn stover.					

*Period III—Feb. 3-March 3:*

10.4	.....	C. S. Meal,	920	43.2	1.52	7.19	11.43
.....	15.8	sorghum.					
10.5	.....	C. seed,	913	32.2	1.15	9.09	12.02
.....	13.8	sorg & cowpea.					
9.3	.....	C. seed,	855	16.4	.58	15.89	23.74
.....	13.9	sorghum .					
8.9	.....	C. seed,	849	12.8	.45	19.43	24.06
.....	11.0	stover.					

*Three Periods—84 days:*

Lot No.	Average daily ration per steer.			Avg. wt. per steer begin- ning.	Avg. gain per steer in 28 days.	Avg. daily gain per head.	Food
	Grain.	Rough- ness.	Chief food.				of
				Lbs.	Lbs.	Lbs.	Grain.
I.	10.8	.....	C. S. meal,	.....	192.	2.23	4.8
	.....	14.6	sorghum.				
II.	10.43	.....	C. seed,	.....	161.8	1.93	5.4
	.....	13.2	sorg. and peas.				
III.	1.70	.....	C. seed,	.....	100.2	1.19	8.1
	.....	13.2	sorghum.				
IV.	9.22	.....	C. seed,	.....	82.4	.98	9.4
	.....	10.	corn stover,				

The most important portion of the above tables is a summary giving the results of 84 days. From this we observe that to produce one pound of increase in weight required:

	Ro
	Grain. ne
Lot I, fed cotton seed meal, sorghum hay, etc. ....	4.82
Lot II, fed cotton seed, cow pea and sorghum hay, etc. ....	5.41
Lot III, fed cotton seed, sorghum hay, etc.	8.12
Lot IV, fed cotton seed, corn stover, etc. ....	9.41

This clearly indicates the superiority of cotton seed meal compared with an equal weight of cotton seed; the superiority of mixed cow pea and sorghum hay over sorghum hay; and the great advantage of the ration containing cow pea hay as compared with those in which roughness consisted of sorghum or corn stover.

In rapidity of gains the rations stand in the same rank. The average daily gain per steer was as follows:

Lot 1, cotton seed meal, sorghum, etc. ....	2.23
Lot II, cotton seed, cow pea and sorghum, etc.	1.93
Lot III, cotton seed, sorghum, etc. ....	1.19
Lot IV, cotton seed, corn stover, etc. ....	.98

## EFFECT OF FEED ON QUALITY OF STEERS.

The steers were sold in the lots at Auburn to Phillips & Hermann, Packers, Birmingham, Alabama.

Naturally there was considerable individual difference between the steers, so that the differences in the price upon each by the packers are not entirely chargeable to the food used.

The packers' estimate of the value of the steers fed on different rations is shown by the following table, giving the selling prices.

*Prices of steers when sold.*

No. worth 3½ cents.	No. worth 3¼ cents.	No. worth 3 cents.	Total value of lot.	Principal foods fed.
3	2	..	\$164.47	C. S. meal, sorghum.
2	..	..	166.25	C. seed, pea. and sorg.
2	2	3	134.29	C. seed, sorghum.
1	1	2	139.55	C. seed, stover.

When sold Lots I and II were judged to be of nearly equal quality, and in this respect far superior to Lots III and IV. The more nitrogenous (narrower) rations affected the more rapid fattening and the higher quality judged by the eye. Judged by percentage of dressed weight or shrinkage during shipping from Auburn to Birmingham, the steers fed on cotton seed meal (Lot I) were superior to Lot III, fed on cotton seed and the same amount of stover. Taking the weights at Auburn as the live weights, and comparing them with the amount of dressed meat obtained in Birmingham, we find that Lot I, on cotton seed meal and sorghum, netted 54.5 per cent.; Lot

II, on cotton seed and mixed hay, netted 51 per cent.; Lot III, on cotton seed and sorghum hay, netted 50 per cent.; Lot IV, on cotton seed and corn stover, netted 48 per cent.

In other words, on this basis alone, the packers have afforded to pay a premium of one-fourth of a pound gross for Lot I, in comparison with Lot IV. It is but fair to add that if live weights in Birmingham could have been ascertained the percentages of meat would doubtless have ranged considerably

#### FINANCIAL RETURNS.

*For 56 days.*—The cattle cost  $23\frac{3}{4}$ c per pound when purchased in November. No charge is here made for freight, since for a small fraction of a carload this was a very heavy expense per head, and since, moreover, the few Alabama cattle that could have been had without any freight charges would have cost no more near home than was paid for the larger and more uniform lot of cattle in Mississippi. During the period between the purchase of these cattle in November, 1903, and their sale, in March, 1904, the packing house in Birmingham, Alabama, the price of the cattle fell. The estimated decline in the price of this grade was about  $\frac{1}{2}$ c per pound. Hence, under normal conditions and with a market neither advancing nor declining, we should have realized  $\frac{1}{2}$ c per pound more than the cattle actually brought, which would have given a fair profit on each of the four lots.

The price paid in our lots at Auburn was  $31\frac{1}{2}$ c per pound for the best ten steers,  $31\frac{1}{4}$  cents per pound for the five steers ranking next, and 3 cents per pound for the five poorest steers.

Since the gains made by most of the steers were unsatisfactory during the third period, and since

believed to have been largely due to the inferior quality (mouldiness) of the corn chop purchased, we have calculated the financial returns at the end of 56 days' feeding, as well as at the end of 84 days' feeding.

For the 56 days embraced in the first two periods of the experiment, the financial results were as follows:

**Lot I:**

To 3878 lbs. live weight, at 2¾c.....	\$106.64	
To 3948 lbs. sorghum hay, at \$6.67 per ton	13.16	
2054 lbs. cotton seed meal, \$22 per ton	22.60	
1025 lbs. corn chop, \$26 per ton.....	13.33	
	<hr/>	
	155.73	
By 4602 lbs. live weight, at 3½c and 3¼c		\$153.69
Loss on 5 steers in 56 days .....		1.84

**Lot II:**

To 3915 lbs. live weight at 2¾c .....	\$107.58	
To 1905 lbs. cowpea hay, at \$10 per ton..	9.02	
1805 lbs. sorghum hay, at \$6.67 per ton	6.02	
1940 lbs. cotton seed, at \$14 per ton....	10.88	
970 lbs. corn chop, at \$26 per ton.....	12.61	
	<hr/>	
	146.11	
By 4563 lbs. live weight at 3½c.....		159.71
Gain on 5 steers in 56 days.....		13.60

**Lot III:**

To 3858 lbs. live weight, at 3¾c.....	\$106.10	
To 3608 lbs. sorghum hay, at \$6.67 per ton	12.03	
1844 lbs. cotton seed, at \$14 per ton....	12.91	
923 lbs. corn chop, at \$26 per ton....	12.00	
	<hr/>	
	143.04	
By 4277 lbs. live weight, at 3¼ and 3c..		\$132.40
Loss on 5 steers in 56 days .....		10.64

**Lot IV:**

To 3889 lbs. live weight, at 2¾c .....	\$106.95	
To 2676 lbs. shredded corn stover, at \$4..	5.35	
1756 lbs. cotton seed, at \$14.....	12.29	
878 lbs. corn chop, at \$26.....	11.41	
	<hr/>	
	136.20	
By 4237 lbs. live wt., at 3½, 3¼, and 3c		\$138.78
Gain on 5 steers in 56 days .....		2.58

In this period of 56 days there is a profit of \$ from the lot fed on a mixture of cowpea and sorghum hay and cotton seed; a profit of \$2.58 from the lot fed on corn stover and cotton seed; a slight loss from the lot fed on cotton seed meal; and a considerable loss from the lot fed on cotton seed and sorghum hay.

*For 84 days.*—During the third period of 28 days the cattle in all lots made very slight gains, largely due, it is believed, to the poor quality of the corn chop fed during the last three weeks of the experiment. On account of the unsatisfactory results of the third period gains will reduce the financial returns for the entire experiment for 84 days.

*Financial returns for 5 steers per lot for 84 days at low, medium, and high prices of foodstuffs.*

	Low.	Medium.	High.
Cotton seed, per ton ....	\$10.00	\$12.00	\$14.00
Cotton seed meal per ton .....	18.00	20.00	22.00
Corn chop, per ton .....	20.00	23.00	26.00
Cowpea hay, per ton ....	5.00	7.50	10.00
Sorghum hay, per ton...	4.00	5.00	6.00
Shredded corn stover, ton	2.50	3.25	4.00

<i>Lot I.</i>	Dr.	Cr.	Dr.	Cr.	Dr.
By 5 steers, selling price..		164 47		164 47	
To 5 steers, bought at 2¾c.	106 64		106 64		106 64
To food fed .....	55 55		64 03		74 55
<b>Profit or Loss .....</b>	<b>Profit</b>	<b>2.28</b>	<b>6.20</b>	<b>Loss</b>	<b>16.72</b>
<i>Lot II.</i>					
By 5 steers, selling price..		166 25		166 25	
To 5 steers, bought at 2¾c.	107 58		107 58		107 58
To food fed .....	39 81		47 94		60 31
<b>Profit or Loss .....</b>	<b>Profit</b>	<b>19.86</b>	<b>Profit</b>	<b>10.78</b>	<b>0 64</b>
<i>Lot III.</i>					
By 5 steers, selling price..		134 29		134 29	
To 5 steers, bought at 2¾c.	106 10		106 10		106 10
To food fed .....	36 56		44 38		53 24
<b>Profit or Loss .....</b>	<b>8.37</b>	<b>Loss</b>	<b>16.19</b>	<b>Loss</b>	<b>25.05</b>
<i>Lot IV.</i>					
By 5 steers, selling price..		139 55		139 55	
To 5 steers, bought at 2¾c.	106 95		106 95		106 95
To food fed .....	29 50		32 99		41 38
<b>Profit or Loss .....</b>	<b>Profit</b>	<b>3.10</b>	<b>0.39</b>	<b>Loss</b>	<b>8.78</b>

At the abnormally high prices of feed prevailing during the past winter, there was a financial loss with every lot of steers fed for 84 days. On a basis of medium prices for food stuffs on the farm, Lot II, fed on mixed cowpea and sorghum hay, cotton seed, and corn chop, afforded a profit of \$10.73, in addition to the value of the manure, all other lots entailing a loss. With unusually low prices for food, every lot, except Lot III, afforded a profit, Lot II leading.

Whatever the price of feed the ration of mixed cowpea and sorghum hay, cotton seed, and corn chop, was the most profitable.

As before stated, the fall in the price of fat cattle between the time of purchase and of sale of these cattle was about half a cent per pound. Had there been a stationary, instead of a declining market, there would have been an additional credit of at least \$20 for each lot, or sufficient to make a profit on every lot except Lot III, with food stuffs at the highest rating.

The production of beef in the South should be thought of as two distinct lines of business, which may be combined on one farm or which may be entirely separate. These divisions are: (1) The growing of cattle from the time of conception until the animal has reached sufficient size to be fed or finished for market, which is usually when a grade of the breed breeds is between two and three years of age; (2) Feeding or finishing cattle, usually between two and three years.

The first operation to be most highly profitable requires an abundance of good pasturage and the almost exclusive reliance on foods grown on the farm, many of which could not be marketed at all unless first converted into some form of livestock. In feeding operations on the other hand, use can often be made of purchased



food, especially of cotton seed meal. But even in feeding cattle in winter there will be, as a rule, no profit to the farmer who utilizes crops raised on his land, for example, such foods as were fed in this experiment to Lot III.

It is generally recognized in states where large numbers of beef cattle are fed for market from 6 to 12 months, that the profit consists chiefly in buying them at a low price per pound and in selling them when fattened at a considerably higher price per pound. A common saying that the difference between the buying and the selling price must be at least one cent per pound if the feeder is to obtain a satisfactory profit in addition to the manure.

Readers are cautioned against concluding that a certain feeding operation is unprofitable simply because every pound of increase in live weight has cost more than the same pound will sell for. The profit lies in the enhanced value of every pound of the increased weight when feeding was begun, an increase in value due to the superior quality (or degree of fatness) of the finished steer. The following example of a steer weighing 900 pounds when feeding was begun, may make the important statement clearer:

	Dr.
To cost of feed, 100 days, at 12c per day.....	\$12.00
By value of 200 lbs. increase in wt., at 3½c.....	
By increased value of original wt. 900 lbs. at 1c....	
Profit .....	\$4.50
	<hr/> \$16.50

Here the feed cost more than the value of the increased weight, or one pound of gain cost 6 cents, but only 3½c. Yet this transaction was directly profitable to say nothing of the indirect profit from the

and from the utilization of food that would otherwise have been wasted.

The essentials to the highest profit in producing beef in Alabama are:

- (1) The use of *thoroughbred* bulls of the beef breeds, and, as soon as practicable, of dams having some beef blood;
- (2) Abundance of good pastures;
- (3) Economical production on the farm of cowpea, sorghum, and other hay, and other foods needed in wintering cattle;
- (4) Intrusting the care of cattle to men who have studied the business both of crop production and of feeding;
- (5) Increased attention to marketing, including the raising of such numbers of beeves and of such quality as will be worth shipping in carload lots to the best markets North or South; equitable freight rates; increased appreciation on the part of local butchers of the superior value of well bred and well fattened beeves; and co-operation in selling and shipping.

#### HEALTH OF THE STEERS.

This was good throughout the experiment, with the exception of an occasional case of scouring. The conclusion was drawn that for these particular lots of steers fed the specified kinds of roughness *ad libitum* it is not safe to feed more than 7.5 pounds of cotton seed meal per day per steer to steers fed as those in Lot I, nor more than 7.8 pounds of raw cotton seed to Lot II, nor more than 7.5 pounds of raw cotton seed to Lot III, nor more than 6.9 pounds of raw cotton seed to Lot IV, which also received corn stover. Although corn stover is considered as constipating, yet cotton

seed, a very laxative food, had to be fed in amounts with the above named roughness that fed with cow pea hay and sorghum, both of which considered more laxative than the stover. Our experience that between 7 and 8 pounds is the maximum ration of raw cotton seed which can be safely fed to steers, without inducing scouring, agrees closely with the results at the Oklahoma Station, where the maximum amount recommended was 8 pounds. (Okla. Sta. Rep. No. 58, p. 37).

*Manure produced.*—As elsewhere stated, the steers spent far more time in the yards than under the sheds and most of the manure dropped in the yards was due to drainage of lots.

About a week after the steers were sold, all the manure lying under the sheds and also the thick layer of manure extending out about six feet from the sheds was weighed before being hauled to the fields. The amount hauled out from the four sheds aggregated 600 pounds of excellent manure. Making allowance for that produced during the preliminary period, it is estimated that about 27,000 pounds was produced during the 84 days of the experiment proper. In other words there was *saved* from the sheltered manure 16½ pounds of manure per steer daily, and doubtless the amount wasted was much greater. No bedding was used except the rejected stems of the hay and straw. Bedding should have been used. At \$2.00 per ton of manure *saved* would average an additional cost of \$6.75 per lot.

#### COST OF PRODUCING BEEF.

To afford final conclusions as to the cost of producing beef, it will be necessary to raise a number of steers in different years and under widely different conditions. However, the following data based on

sults with three steers is offered as a preliminary contribution to our knowledge on this subject.

An account was kept of the amount of food consumed by each of three calves from the age of two or three weeks until taken from the pasture at the end of the second grazing season, November 1, 1903, when we were offered 3 cents per pound for them by a local butcher. These animals were Dangus, a steer sired by a registered Angus, and out of a large cow that seemed to be about  $\frac{1}{2}$  Jersey; Toom, a steer sired by a registered Red Poll bull, and out of a large native cow, apparently a Shorthorn grade; Holstein, a cross-bred Shorthorn Holstein. All of these were dropped between September 21 and December 17, 1901. The history of these individuals is as follows: For the first one or two weeks after birth the calves, then belonging to private individuals, subsisted on the milk afforded by one teat of the dam. One of these calves, Holstein, dropped on the Station Farm, was never allowed to suck, but was fed for the first few weeks on whole milk or part whole milk. The account for food stands as follows:

*Dangus*—

	Dr.	Cr.
2009 lbs. skimmed milk, at $\frac{1}{4}$ c .....	\$5.02	
172 lbs. bran and corn meal, first winter, at 1c.....	1.72	
214 lbs. leguminous hay, first winter, at $\frac{1}{2}$ c.....	1.07	
180 lbs. grain, first spring at 1c.....	1.80	
Eight months' pasturage at 25c.....	2.00	
294 lbs. cotton seed, second winter, at $\frac{5}{8}$ c.....	1.84	
132 lbs. cotton seed meal and wheat bran, second winter, at 1c .....	1.32	
399 lbs. hay, second winter, at 1-3c.....	1.33	
86 lbs. green rye, at $\frac{1}{2}$ c.....	.11	
8 $\frac{1}{2}$ months' pasturage, at 30c.....	2.55	
<hr/>		
To cost of food up to age of 25 months.....	18.76	
By weight at 25 months (Nov. 1, '03) 888 lbs. at 3c..		26.64
Excess of value over cost of feed.....	7.88	
<hr/>		
	\$26.64	\$26.64
<hr/>		
Cost of food per pound of live weight, 2.11c.		

*Toom (1/2 Red Poll)—*

	Dr.
2100 lbs. skim milk, at 1/4c .....	\$5.25
131 lbs. wheat bran, first winter, at 1c.....	1.31
248 lbs. rice meal, first winter and spring, at 5/8c....	1.55
311 lbs. leguminous hay, first winter, at 1/2c.....	1.55
8 months' pasturage, at 25c.....	2.00
361 lbs. cotton seed, second winter, at 5/8c.....	2.25
180 lbs. wheat bran and cotton seed meal, second winter, at 1c .....	1.80
484 lbs. sorghum hay, second winter, at 1-3c.....	1.61
86 lbs. green rye, at 1/8c.....	.11
8 1/2 months' pasturage at 30c.....	2.55
To total cost of feed to 25 months .....	19.98
By 848 lbs. live weight, at 3c .....	
Excess of value of steer over cost of feed .....	5.46
	<hr/> \$25.44

Cost of food per pound of live weight, 2.35c.

*Holstein-Shorthorn—*

1554 lbs. skim milk, at 1/4c....	3.88
144 lbs. wheat bran and corn meal first winter, at 1c..	1.44
150 lbs. leguminous hay at 1/2c .....	.75
8 months' pasturage, at 25c .....	2.00
374 lbs. cotton seed, second winter, at 5/8c.....	2.35
200 lbs. wheat bran and corn meal, 2nd winter, at 1c.	2.00
393 lbs. corn stover, second winter, at 1-5c.....	.79
51 lbs. vetch hay, second winter, at 1/2c.....	.26
84 lbs. green rye, at 1/8c.....	.11
8 1/2 months' pasturage at 30c.....	2.55
27 lbs. cotton seed meal at 1.1c.....	.30
To total cost of feed to 23 months .....	16.43
By 365 lbs. live weight at 3c .....	
Excess of value over cost of feed .....	9.52
	<hr/> \$25.95

Cost of food per pound live weight, 1.9c.

From the above financial statement, it will be seen that at the high prices of recent years, the total cost of food eaten by each animal from the age of four weeks until 24.3 months old, averaged \$18.

that the value of the average steer at this age, weighing 867 pounds, was \$26.01. This gives an average difference of \$7.62 between cost of food and selling price, and must cover the cost of the calf at 2 to 4 weeks old, and other items of expense.

A much more favorable financial showing could have been made had not each of these steers been used in feeding experiments during each of two winters. There was no special effort to grow the animals as economically as possible when economy conflicted with experimentation as to the comparative value of foods. It is planned to grow in future a lot of grade beef calves with the primary object of producing beef as cheaply as the conditions at Auburn permit, and we are confident that with this end in view the cost can be greatly reduced below the figures given above by the following changes in the method of handling the animals:

(1) By decreasing the amount of grain in winter and the substitution for it of leguminous hay and winter pastures.

(2) By the use of cheaper grain food, chiefly cotton seed.

(3) By causing the calves to be dropped after Christmas and keeping them only two winters if they are ready for market.

In order to make it easier for each reader to draw his own conclusions from the data above and to place his own local prices on the foods used, the following summary of the average amounts of food consumed per animal up to the age of 24.3 months, has been prepared.

*Average amount of food consumed by grade from age of 2 to 4 weeks to age of 24.3 months.*

*First year—*

1888 pounds skim milk.  
258 pounds grain.  
225 pounds hay  
8 months' pasturage.

*Second year—*

480 pounds grain, chiefly cotton seed.  
1276 pounds sorghum hay and corn stover.  
8½ months' pasturage.

From the above detailed data previously not learn that the average cost of feed and pasturage for a steer up to the age of 24.3 months was \$18.39. Of the cost incurred during the first year for calves dropped in the fall was \$10.45; the cost of food and pasturage the second year was \$7.94.

The average cost of food per pound of live weight was 2.12 cents, which cost could have been reduced. The prime object in feeding these animals had contentment been the cheapest production of beef.

#### RICE MEAL VERSUS CORN MEAL FOR CALVES

Calves dropped in the fall of 1901 were used in the experiment. They were grades of the beef breeds. Each calf was fed a moderate ration of skim milk, alfalfa, lespedeza (Japan clover) hay as it would eat, and a small amount of the grain mixture named below as it would eat without waste. The calves were first fed for nearly two months on the ration which each was to receive during the experiment proper.

During these two months the amount of grain fed was small, and especially during this time the rice

proved decidedly inferior in palatability to the corn meal. Indeed, it was impossible to make the calves eat sufficient of the rice meal, so that it became necessary to use wheat bran as one-third of the weight of the rice meal ration, and of course wheat bran likewise constituted one-third of the corn meal mixture.

The experimental period proper extended from January 1 to April 2, 1902, a period of ninety-one days. The detailed records for each calf are given in the table below:

*Rice meal versus corn meal for calves.*

Name.	Grain, lbs.	Hay, lbs.	Skim milk, lbs.	Live wt. Jan. 1. Lbs.	Gain, lbs.	Breed.
<i>Rice meal lot—</i>						
Toom .....	153	237	1620	180	152	½ Red Poll
Foxella ..	252	300	417	195	137	¾ Angus
Total .....	405	537	2037	375	289	
<i>Corn meal lot—</i>						
Andrew .....	261	306	475	192	150	¾ Angus
Dangus ..	138	214	1609	125	200	½ Angus
Total .....	399	520	2084	317	350	

The calves receiving rice meal made an average daily gain per head of 1.6 pounds, while the lot eating corn meal averaged 1.9 pounds per head.

To make one pound of increase in live weight, the following amounts of food were needed:

	Rice meal.	Corn meal.
lbs. grain required to make 1 lb. of gain...	1.40	1.24
lbs. hay required to make 1 lb. of gain...	1.85	1.49
lbs. skim milk required to make 1 lb. gain.	7.04	5.70



From the figures given above it will be seen that meal was decidedly superior to rice meal in giving rapid growth, and in requiring a smaller amount of feed per pound of growth. Corn meal is also superior in position and palatability. The rice meal used evidently consisted partly of ground rice hulls.

After an experience of five months in feeding rice meal to calves, we are led to the conclusion that it is not especially desirable food for calves. However, the results made by these calves on rice meal indicate that when the price is very much cheaper than that of corn that it may be thus used. A briefer experience in feeding rice meal suggests that it may be found to be a very desirable food for calves, as also we have found it for hogs.

#### SHREDDED CORN STOVER VERSUS SORGHUM HAY

During the winter of 1902-03 an experiment was begun to determine the relative values of shredded corn stover and sorghum hay, using yearling cattle, mostly which were grades of the beef breeds. The experiment was interrupted by sickness of two of the animals, but was not due to the feed. In the fifty days before the interruption the rate of daily gain was much greater with the sorghum lot than with those fed the corn stover. The latter was of medium to poor quality and was decidedly unpalatable.

Of the corn stover offered, 37 per cent. remained uneaten in the troughs, although this food was fed in limited quantities as to make the animals consume as large a proportion of it as possible. During a part of the time the stover was sprinkled with brine, but this did not noticeably increase its palatability.

The sorghum was eaten clean. At first it was cut in short lengths, but this was found to be unnecessary.

yearlings consuming a bright good grade of sorghum hay fed whole as well as when cut. The grain ration fed in connection with both the stover and the sorghum hay consisted by weight of four parts cotton seed, one part cotton seed meal, and one part wheat bran, a very satisfactory combination.

#### MANURE MADE.

*Manure from a young calf.*—A Jersey heifer calf, dropped October 15, 1901, was kept in a box stall from November 3 to April 30, 1902, except that for one day every two weeks she was allowed to run in a lot, and the manure for this day was thus lost. Pine leaves were freely used as bedding, and in more liberal quantity than is customary.

The total amount of manure, including bedding, as weighed a week after the close of the experiment was 1645 lbs. produced in 176 days. This is about 9.4 lbs. of manure and bedding per day, which is a larger amount than would be obtained with the usual amount of bedding.

During this time this calf consumed 204 lbs. of wheat bran, 323 lbs. hay (chiefly lespedeza and crimson clover), 92 lbs. of whole milk, and 1191 lbs. of skim milk.

Assuming 6 lbs. of skim milk as equivalent to 1 lb. of grain, we have a total amount of feed eaten, equivalent to about 740 lbs. of grain and hay. Hence for every pound of air-dry food consumed there was produced about 2.2 lbs. of manure.

*Manure produced by yearling beef animals.*—Beginning January 17th, 1902, the combined liquid and solid manure dropped by six head of yearling cattle, most of which were grades of the beef breeds, was saved and

weighed daily. The arrangement for catching the pings consisted only of the usual wooden manure g and the use of pine leaves as bedding. The floors of stalls were of clay, and hence there was some loss of liquid manure from the four steers. The cattle had taken from the barn for a short time twice a day water, which represented the loss of such manure as dropped during a daily period of about one-half hour. From these statements it will be seen that the effort was rather to determine the amount of manure that the farmer could expect to save from cattle of this kind, under shelter, than to determine from a scientific standpoint the actual and exact weight of the excreta.

The results for the twenty-day period were as follows:

Solid and liquid manure saved from 6 yearlings in 20 days, excluding bedding .....	
Bedding used .....	
Total manure per head daily, excluding bedding .....	
Total manure per head daily, including bedding .....	
Total cotton seed, cotton seed meal, and wheat bran fed .....	
Total sorghum hay and corn stover actually consumed .....	
Total food .....	
Pounds liquid and solid manure saved per pound of dry food fed .....	

At this rate six yearlings in one month would produce 3600 lbs. of manure, or, including bedding, about 4 tons. In other words, a beef animal weighing about 1200 lbs. would produce a ton of manure in about 3 months.

#### GRAZING YEARLING STEERS ON GREEN RYE.

For three weeks, beginning March 11, 1903, four yearling steers, averaging about 500 pounds in weight, were placed on a field of rye, sown on thin upland on the

farm at Auburn during the preceding September. Being placed on this pasture they had for several years been accustomed to eating green rye and had been allowed to make the fill that usually occurs when cattle are first placed on green food.

The increase in live weight was 1.67 pounds per head per day.

The rye was about two feet high when the cattle were put on it, and although too old and coarse to be as palatable as at a younger stage, yet it was eaten clean.

To determine the increase in live weight made by thoroughbred and grade cattle of the beef breeds, weighings were made throughout the pasture season for such animals in the Station herd as were kept continuously on pasture. The following table gives first, the results for five calves, grades of the beef breeds; and for second, for mature cows, thoroughbreds and grades of the beef breeds, for the time that they were kept continuously on pasture.

*Gains of Station beef cattle on pasture alone.*

Name.	Breed.	Weight in spring.	Gain, lbs.	Days.	Average daily gain, lbs.
1st.	½ Red Poll.....	345	160	214	.74
2d.	½ Angus .....	340	152	214	.71
3d.	Hol. short .....	315	177	214	.82
4th.	Short horn .....	455	95	214	.44
5th.	¾ Angus .....	370	135	214	.63
6th.	½ Angus .....	238	187	184	1.01
7th.	Red Poll .....	1050	200	183	1.09
8th.	Short-horn .....	1010	240	183	1.31
9th.	Grade Angus.....	1045	185	183	1.01
10th.	Grade Angus.....	880	145	183	.78
11th.	Angus .....	855	245	183	1.34

From the above table it will be seen that the average daily gain of calves having from 50 to 100 per cent beef blood, was .72 pound, and that the average gain of thoroughbred and grade beef cows was 1.2 pounds.

The pasture was strictly unimproved, or in its natural condition, and consisted chiefly of old poor upland pine, too poor for cultivation, on which the principal grasses were lespedeza and broom sage.

In order to determine the amount of beef which could be produced from an acre of pasture, a portion of the pasture of the Alabama Experiment Station farm was fenced off and four young steers were kept on it from April 1 to November 1, 1903. The following table gives the breeding of the animals, their weight on April 1, and the gain made during the next seven months.

*Gains made by four yearling steers from April 1 to November 1, 1903.*

Name.	Breed.	Weight April 1st.	Weight Nov. 1st.	Gain on pasture.
Toom.....	½ Red Poll .. . . .	590	848	258
Dangus.....	½ Angus .. . . .	535	888	353
Holstein.....	Holst-shorthorn .. . . .	555	865	310
Cull.....	Scrub .. . . .	445	715	270

The area in this pasture was 13.11 acres, of which about 3.1 acres was covered by a dense growth of pine and other timber. On this area the total increase in live weight made by the four steers was 1191 pounds, or the rate of 91 pounds of increase in live weight for each acre, including thickets. At 3 cents per pound, this is equivalent to a rental of \$2.73 per acre for the tract, although, if cultivated, the rental value of the entire tract would not have exceeded half this amount.

Moreover, in the season of 1903, when rains were so favorably distributed for the growth of pasture grasses the steers were not able to consume the entire growth. We estimated that there was food enough for two more similar steers. For three weeks in November this pasture supported seventeen two-year-old steers, without other food.

The average daily gain per head for the three yearling steers with beef blood on pasturage alone was 1.43 lbs. and the average gain for the pasturage season was 307 lbs. per head.

#### GAINS MADE BY SCRUB CATTLE ON PASTURES.

*Conditions of the experiment.*—It seemed a matter of importance to study the gains made by scrub cattle (unimproved natives) during the grazing season. Hence in the spring of 1901, an experiment was begun in cooperation with a farmer living in Macon county, Alabama, who every year pastures a large number of cattle of scrub or Jersey blood. One of the principal objects in view was to ascertain what class of animals, or rather animals of what age, made the most rapid gains, or brought the most profit to the dealer or stockman pasturing cattle.

The Station furnished the scales and its representative weighed the cattle several times each year. The pasture is so large and the cattle so wild and the stock so frequently changed by sales and new purchases that only for a few of the several hundred animals weighed are the records in any sense complete. However, by combining the results for the three years, we obtained averages which are believed to have some suggestive value. The pasture on which these cattle grazed consisted of old fields and swampy thickets with a small amount of switch cane. The principal growth relished by cattle

consisted of lespedeza, broom sage, crab grass, grasses, and switch cane. This is strictly an unimproved pasture, no seed of any kind having been sown. It is probably an average native or unimproved pasture on sandy land. Most of it is made up of old fields that have been uncultivated for many years, and some areas recently thrown out of cultivation. The soil ranks as poor sandy land, worth, perhaps, if in cultivation, \$3 to \$6 per acre.

*Relative gains during the pasturage season in native scrub cattle of different ages.*

By averaging the results for the different years we found that during the portion of the pasturage season covered by our weighings the daily gain made by the different classes of stock for periods of 138, 183, and 210 days (these being the respective intervals between weighings during the three years, were as follows:

*Daily gains made by scrub cattle on native pasture alone.*

9 cows averaged per day .....	
14 heifers (300 lbs. and above) averaged .....	
7 yearlings, male and female, averaged .....	
4 sucking calves averaged .....	
13 steers and bulls (above 300 lbs.) averaged .....	

It was impracticable to make weighings early in the spring and late enough in the fall to include the entire pasturage season. However, we are confident that the period during which cattle made average gains was at least seven (7) months, or from April 15th to November 15th. Hence, in order to make the figures clearer we have calculated from the figures above the gains for a pasturage season of 210 days and the results are given below:

*Gains made by scrub cattle during a season of 7 months on pasture.*

	Lbs.	Value of increase at $2\frac{1}{2}c$
Mature cows, sucking calves . . . .	59	\$1.48
Heifers above 300 lbs. . . . .	172	4.30
Yearlings, up to 300 lbs . . . . .	103	2.58
Sucking calves . . . . .	141	3.52
Young steers and bulls . . . . .	149	3.73

It is obviously unfair to compare the mature cows with the other animals, since the slight gains made by them are due in large measure to the fact that they had nursing calves at their sides. Excluding the cows, we find that the largest gains were made by the heifers that at the beginning of the season weighed more than 300 lbs. It is notable that the heifers should have beaten the steers of corresponding weight. The sucking calves made considerably greater gains than did the yearlings, but it cannot of course be said that sucking calves are most profitable stock for grazing, for the reason that the raising of this class of animals necessitates supporting the dam, whose gain is slow.

A more accurate idea of the relative profit of grazing these different classes of animals may be obtained by ascertaining what per cent of increase, as compared with the weight in the spring, is made by the average animal of each class during the season of abundant pasturage.

*Percent increase during pasturage season of 7 months.*

	Avg. wt. in spring.	Per cent. increase.
Cows, suckling calves . . . . .	615	8
Heifers . . . . .	440	39
Yearlings, male and female . . . . .	269	38
Sucking calves . . . . .	272	51
Steers and bulls . . . . .	428	35

According to this showing, if scrub cattle are bought and sold at the same price, the investment should return a gross profit of 39 per cent. with large heifers, 38 per cent with yearlings and 35 per cent. with steers. Since



the selling price per pound is considerably above the purchase price, the showing is still more favorable. Of course, from this must be deducted a number of expenditures, including interest or rent and loss by death. If these figures are representative they show that either one of these three classes of scrub cattle can be pastured at practically the same profit.

However, for cattle to be kept over winter and feed except the range the losses by death are much greater with the calves and yearlings than with older cattle. To form a better idea of the weights of these classes of cattle, the reader is referred to the table in the Appendix.

*Annual growth made by scrub cattle under range conditions.*—It would be of interest to ascertain the average gain from year to year and the average gains for a year under this system of maintaining scrub cattle without any food in winter. From causes alluded to in our records on this point are fragmentary, the showing constantly changed.

Ten head of cows averaged an annual increase in weight of only twenty-four pounds, this poor showing being attributable, of course, to the calves that were suckled. The history of five young steers, weighed at intervals for two years is of interest as showing the effect of age on the rate of growth of very young cattle. The following table gives the details:

*Growth made by young scrub steers in two years.*

Steer No.	Weight first spring.	Gain first year.	Gain second year.	Gain two years.
	Lbs.	Lbs.	Lbs.	Lbs.
11 .....	218	120	170	290
56 .....	238	128	190	318
57 .....	326	168	172	340
67 .....	304	88	170	258
84 .....	234	64	178	242
Average .....				

From this table we see that the average gain per year was 145 pounds, worth at  $2\frac{1}{2}c$  per pound \$3.67. The increase made by these young steers

during the first year 42 per cent over their weights in the spring. The same steers made during their second year an increase of 44 per cent. over their weights of the second spring. In other words, there was little difference in the profits during the two years, in spite of the difference in the age.

*Loss of weight by range cattle during winter.*—The management of this herd of cattle included many matters, which in the opinion of the writers, were at fault, or could have been improved; for example, the almost exclusive purchase of scrub or grade Jersep cattle rather than the raising of calves from the owner's cows and sired by a thoroughbred bull of any of the beef breeds. Another great mistake in management, we believe, consisted in requiring the cattle to subsist throughout the entire winter without any food whatsoever except what they could obtain on the range from canebrakes, cotton stalks, corn stalks, etc. Since our weighing was not made until May of each year, when the cattle had been on pasturage for about a month, it is not possible to estimate exactly the amount of decrease in live weight occurring between the time that the fall pasturage failed and that the grasses put out in the spring.

Of 22 animals of all ages weighed October 1, 1901, at least a month before pasturage greatly deteriorated, and again weighed May 7, about six weeks after the pastures put out in spring, 64 per cent lost in weight during this period of six and a half months.

The losses in weight would have been much greater had our weighings been made about November 15th and April 1st.

It is believed that the shrinkage in live weight during the winter, the utter loss of all food obtained from pasture and range from October to May, and the considerable number of deaths during the winter, more than counterbalance the saving of feed, which is the only point of advantage claimed for this system. Our advice is to winter only so many cattle and those of such quality that it will be feasible and profitable to supply them with hay, if not with both hay and cotton seed, after the pastures or ranges fail in December, January, or February.

**APPENDIX.**  
*Individual weights, gains, and percentages of dressed weight of grade steers.*

Lot No.	Name or Number of Steer.	Initial Weight.	Gain				Average daily gain.	Dressed weight.	Principal Food.	
			First 28 days.	Second 28 days.	Third 28 days.	Total 84 days.			Roughness.	Concentrate.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	%		
I	Dangus ..	803	122	61	47	230	2.74	56.6	Sorghum	Cotton seed meal.
I	Daddy ..	877	83	90	40	213	2.54	54.3	Sorghum	Cotton seed meal.
I	42 ..	832	88	75	44	207	2.47	55.7	Sorghum	Cotton seed meal.
I	153 ..	733	52	26	19	97	1.15	55.4	Sorghum	Cotton seed meal.
I	308 ..	633	72	55	64	191	2.27	49.3	Sorghum	Cotton seed meal.
I	Average .....	785	83.4	61.4	42.8	188	2.23	54.5		
II	18. ..	795	56	40	50	146	1.74	50.9	Sorghum and cowpea	Cotton seed.
II	53. ..	707	59	81	31	171	2.04	50.7	Sorghum and cowpea	Cotton seed.
II	91. ..	838	114	73	37	224	2.67	51.7	Sorghum and cowpea	Cotton seed.
II	222 ..	795	70	60	30	160	1.90	50.6	Sorghum and cowpea	Cotton seed.
II	224 ..	780	17	78	13	108	1.29	51.7	Sorghum and cowpea	Cotton seed.
II	Average .....	783	63.2	66.4	32.2	162	1.93	51.		
III	Holstein .....	797	21	39	13	73	.90	49.1	Sorghum	Cotton seed.
III	Roan .....	802	68	37	41	146	1.74	*	Sorghum	Cotton seed.
III	60 ..	735	71	28	—3	96	1.14	51.5	Sorghum	Cotton seed.
III	84. ..	822	83	11	32	126	1.50	51.3	Sorghum	Cotton seed.
III	237 ..	702	48	13	—1	60	.71	50.6	Sorghum	Cotton seed.
III	Average .....	772	58.2	25.6	16.4	100	1.19	50.6*		
IV	Toom .....	746	72	9	26	107	1.27	53.4	Corn stover	Cotton seed.
IV	10. ..	646	52	—3	13	62	.49	49.8	Corn stover	Cotton seed.
V	...	638	57	8	15	82	1.04	50.6	Corn stover	Cotton seed.

*Weights and gains made during the pasturage season by scrub cattle in Macon County.*

		Age, years.	Year.	Days between weighings.	Weights in spring.	Gain in one pasturage season.	Daily gain.
	<b>Cows 4 years and older</b>						
68	.....	10	1902	238	652	38	.....
46	.....	8	1902	238	536	82	.....
121	.....	4	1902	238	520	80	.....
62	.....	4	1902	238	586	40	.....
68	..... (?)	8	1903	183	666	64	.....
196	.....	8	1903	183	638	84	.....
189	.....	4	1903	183	700	46	.....
29	.....	10	1903	183	626	36	.....
	<b>Average</b> .....				615	59	.28
	<b>Helpers above 300 lbs..</b>						
71	.....	2	1901	136	510	146	.....
79	.....	2	1901	136	360	122	.....
58	.....	1½	1901	136	310	118	.....
81	.....	1	1901	136	356	68	.....
16	.....	3	1902	238	408	112	.....
22	.....	3½	1902	238	472	146	.....
107	.....	3½	1903	183	542	232	.....
107	.....	2½	1902	238	418	152	.....
194	.....	2½	1903	183	542	88	.....
187	.....	2½	1903	183	600	188	.....
197	.....	2	1903	183	482	198	.....
193	.....	2	1903	183	428	192	.....
51	.....	2½	1903	183	398	148	.....
101	.....	1½	1903	183	342	176	.....
	<b>Average</b> .....				440	149	.82
	<b>Yearlings, up to 300 lbs</b>						
76	.....	1	1901	136	258	24	.....
84	.....	1	1901	136	234	86	.....
36	.....	1	1901	136	256	128	.....
81	.....	1	1901	136	356	68	.....
114	.....	1	1902	238	218	88	.....
124	.....	1½	1902	238	274	94	.....
18	.....	1½	1902	238	272	118	.....
	<b>Average</b> .....				269	89	.49

*Weights and gains made during the pasturage season  
cattle in Macon County.*

		Age, years.	Year.	Days between weighings.	Weights in spring.	Gain in one pasturage
	<b>Sucking calves.</b>					
40	.....	1½	1901	136	230	
131	.....		1902	238	306	
12	.....	1	1901	136	262	1
51	.....	1	1901	136	293	1
	<b>Average</b> .....				273	1
	<b>Steers above 300 lbs.</b>					
96	.....	3	1901	136	520	
73	.....	2	1901	136	584	1
27	.....	1½	1901	136	419	
38	.....	2	1901	136	426	1
41	.....	3	1901	136	486	1
67	.....	1½	1901	136	304	
63	.....	1½	1901	136	356	1
65	.....	2	1901	136	477	1
87	.....	2	1901	136	470	1
69	.....	1½	1901	136	361	1
11	.....	1½	1902	238	338	
40	.....	1½	1902	238	304	
82	.....	2½	1903	183	522	2
	<b>Average</b> .....				428	1

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*E. Mead Wilcox.*

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ALABAMA.



# Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute.

AUBURN.

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## The Mexican Cotton Boll Weevil.

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By

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Plant Physiologist and Pathologist.

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MONTGOMERY, ALA..

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# THE MEXICAN COTTON BOLL-WEEVIL.

BY EDWIN MEAD WILCOX.

## *Introduction.*

In twenty years the Mexican cotton boll-weevil (*Anthonomus grandis* Boh.) has developed from a rather obscure species to one of supreme importance with respect to the production of the world's supply of cotton. The infested regions are taking desperate measures to destroy the pest or to adjust and modify the present methods of cultivation in such manner that cotton may still be grown at a fair profit in the infested regions. The recent appropriation of \$250,000.00 by the Congress of the United States for the exhaustive study of the boll-weevil problem from all points of view has given to the boll-weevil a national importance.

It seems desirable to present to Alabama cotton growers our present information upon this very important subject together with the suggested methods of controlling the boll-weevil should it ever become established within the borders of our State. This bulletin may therefore be said to result from an application of the old adage, "forewarned is forearmed." No claim for originality is made as to the facts stated, but the reader is referred to the papers mentioned in the Bibliography at the close of the bulletin for the most recent original investigations of this subject. The facts given in the papers cited have been freely drawn upon in the preparation of this bulletin.

## INTRODUCTION AND PRESENT DISTRIBUTION OF THE BOLL WEEVIL.

The boll-weevil probably crossed the Rio Grande river into Texas about 1892—at least that is the opinion of the



planters in that region. By 1894 it had spread to a dozen counties in southern Texas bordering the Rio Grande river and the Gulf of Mexico. At this time it was brought to the attention of the United States Department of Agriculture; the Division of Entomology commenced late during 1894 the investigation of the weevil and has continued this investigation to the present time. The Department of Entomology of the Texas Experiment Station has also rendered aid in the investigation. The recent appropriation by Congress has made it possible to concentrate on the boll-weevil problem the efforts of a large number of persons and the weevil is now receiving more attention than probably any other insect pest in the world.



**Fig. 1. Map showing the distribution over Texas and Louisiana of the boll weevil at intervals since its first appearance in Texas. (Bull. 45, Div. Ent., U. S. Dept. Agr.)**

The map shown as Fig. I presents graphically the present known distribution of the weevil as well as the distance it has made over the area indicated since its first appearance in 1892. From a study of the insect's means of reaching new territory it has been estimated that the weevil will be at work throughout the entire cotton belt of the South in 15 to 18 years. In Texas during the past ten years the weevil has made an annual advance of about 50 miles.

Having this danger in mind and to prevent the accidental or intentional introduction of the pest into the State the last Legislature passed the following law, which is here quoted in full:

*An act to prevent and prohibit the importation of seed cotton from cotton affected with Texas boll weevil.*

SECTION 1.—*Be it enacted by the Legislature of Alabama,* That no person shall import or bring into the State of Alabama any seed from any cotton affected with the pest known as the Texas boll weevil, nor the seed from any place where the cotton has been affected with the boll weevil.

SEC. 2.—Any person who violates the provisions of Section 1 of this act shall be guilty of a misdemeanor, and on conviction, shall be fined not less than ten dollars (\$10.00) and not more than five hundred dollars (\$500.00). [H. 877. No. 559. Approved Oct. 6, 1903.]

The Legislature can, after all, however, do nothing more in the case than build up public sentiment and arouse interest in the weevil problem and if cotton planters permit the weevil to become established in this State it will be the result of their own neglect. Planters and others will derive a great benefit upon themselves and upon the State by promptly reporting and sending specimens of suspected boll-weevil to the Alabama Experiment Station. All such insects should be killed with chloroform or other means before being forwarded through the mails and then be enclosed in tin or wooden boxes.

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## AMOUNT OF DAMAGE DUE TO BOLL-WEEVIL.

There is frequently a tendency to greatly exaggerate crop losses, but a very conservative estimate shows the damage done by boll-weevil in Texas amounts annually to about \$15,000,000. The loss in the weeviled counties of Texas is certainly fully one-half of the crop. If we assume that the total cotton crop of the United States has a value of \$500,000,000 it will be seen that when the boll-weevil is found throughout the cotton belt the annual loss will be at least \$250,000,000 annually. All these estimates are based upon the failure of the planters to adopt any measures to check the spread of the pest or particularly to reduce the extent of its damage. We shall see that there is much to be gained that cotton may be grown at a profit in the infested regions if the planters will adopt the modern methods of planting and cultivation suggested and urged by the Bureau of Entomology of the Department of Agriculture.

## LIFE HISTORY OF INSECT.

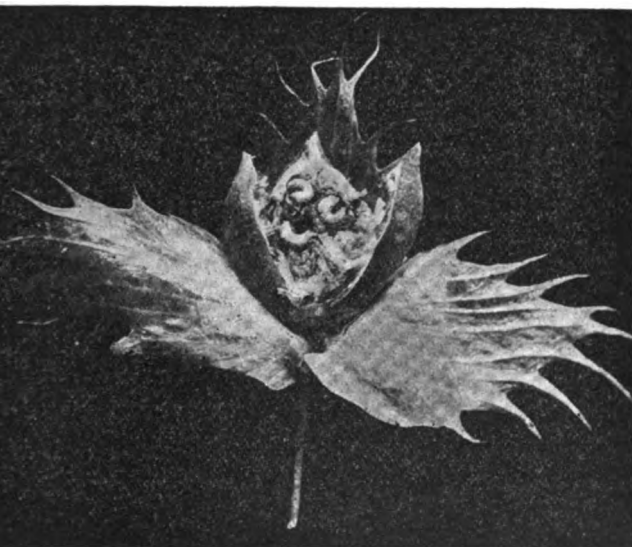
### EGG.

The female weevil deposits the egg in a cavity made by eating into either the square or boll. These cavities are made usually between the middle and the tip in the case of squares, but seem to occur at random in the case of bolls. The length of the egg stage in the vast majority of cases varies from 2 to 5 days. It has been observed that but a single egg is usually deposited in a boll if the female is able to find bolls not previously injured. This habit of selecting a fresh boll for the position of each egg accounts for the large number of bolls injured by a single female. It is probable that a single female may deposit as high as 200 eggs during the season.

## LARVA.

The larva when it escapes from the egg is a delicate grub about 1-25 of an inch long, and without legs.

(Figs. 2 and 3.) If it were not for the small head and mandibles the larva would be quite as inconspicuous as is the egg itself. In the squares the larva probably molts but twice while growing, but it is not certain that in the bolls, and perhaps also in the squares, there is also a third molt.



*Three large larvae in a boll. x3. (Bull. 45, Div. Ent., U. S. Dept. Agr.)*

During the warmer parts of the summer it is probable that the larval stage in the squares lasts not over 6 days, but in colder weather the period is of course longer. If frosts do not kill the larva in the bolls, and they continue their growth and complete their development after the occurrence of a frost.

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In the bolls the larval stage last probably longer and here 6 to 7 weeks is near the length of the larval period.

As the boll reaches maturity the mature larva, to 1-3 of an inch long, ceases feeding and comes surrounded by a sort of cell composed of larval excrement mixed with the lint, etc. In this cell the pupation and formation of the adult occurs. The cells are shorter and thicker than the seeds, with which they are at times confused.

#### PUPA.

When the insect enters this stage it has the form of the adult, but its color is white or cream. (See Fig. 3.) The pupal stage lasts in squares on the average three to five days in warm weather, but may reach a maximum of ten days in cold weather. The pupal stage is certainly longer in bolls than in squares, but no definite data are at hand on this point.

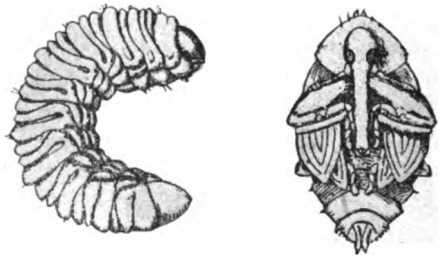


Fig. 3. *Larva, to the left, and pupa, to the right.* x6. (*Bull. 189, U. S. Dept. Agr.*)

The final molt of the pupa requires about a half day.

#### ADULT.

About 2 or 3 days are required for the adult to acquire the color typical of the species and to acquire sufficient strength to enable it to walk. The weevils mature much in size dependent largely upon the question of

available food supply. With the proboscis extended they vary from 1-8 to 1-3 of an inch in length and in the middle of the body are from 1-25 to 1-8 of an inch broad. (See Fig. 4.)

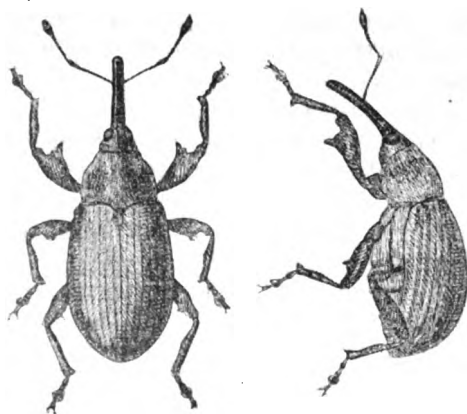


Fig. 4. Mexican cotton boll weevil (*Anthonomus grandis*).  $\times 3$   
(Bull. 45, Div. Ent., U. S. Dept. Agr.)

The color of the boll weevil varies with the size—the smaller weevils being darker brown and the larger weevils being light yellowish brown. The average color between these two extremes is a gray brown or dark yellow brown. The yellowish color of the larger specimens is due to the presence of numerous yellowish scales that are more conspicuously formed in large than small weevils. These scales, however, often become rubbed off, leaving the dark brown color of the chitin. The sexes, however, cannot be distinguished as is often supposed by any question of either size or color.

The average length of life of the adult weevils on squares is about 10 weeks for males and 9 weeks for females. On the bolls it is nearly 3 weeks for males, but only about 2 weeks for females.

#### FEEDING HABITS.

Until the females begin to oviposit the feeding habits of both sexes are alike. Bolls and leaves are seldom fed

upon so long as squares are available. The puncture from the outside is only large enough to admit the head of the weevil, to the tip of which the mouth parts are attached. The principal part of the square eaten consists of the anthers and pollen sacs. When these are reached the cavity is broadened out to give to the whole cavity the shape of a flask.

The males are known to make on an average about 6 to 9 feeding punctures per day, though during the first few days of adult feeding existence they may make as few as 3 punctures per day. They average, however, about 3 punctures to a square, and hence really do little damage. The males, unlike the females, most frequently chose to puncture the square very near the center.

After the females begin to oviposit they eat less of the square or from a single puncture than before. Since we have said that as a rule a female oviposits but once on a square and since most of her eating is done in connection with oviposition, it becomes clear that the amount of damage done by the females is much greater than that due to the males.

It has been demonstrated by experiment that the American upland cottons are much less subject to attack by the weevils than any others, and that the Egyptian (Mit Afifi) cotton is more subject to attacks than any other variety. It is now known also that the boll worm has no food plant, native or cultivated, other than the various species and varieties of cotton.

#### NUMBER OF GENERATIONS.

No hard and fast line can be drawn between the different broods of the weevil—not even between the hibernated weevils and those of the first spring generation.

It is probable that in the southern part of Texas four broods occur between 1 May and 1 December—this on the assumption that the average life cycle of a generation from egg to egg is about 42 days. In northern Texas and probably also in this region not more than 4 broods would occur.

### HIBERNATION.

Even after the cotton has been entirely killed by frost the weevils may be seen moving about in the fields. In southern Texas the weevil may hibernate as either larva, pupa or adult, but they most commonly hibernate in the adult condition. The majority of weevils that successfully hibernate over winter are those developed in the fall—whose vitality was consequently not exhausted by oviposition or otherwise before the approach of winter.

The average hibernation period is from 1 December to April, or about 4 months. Given a dry sheltered place as high as 1-6 of the weevils will live through the winter.

### DISSEMINATION.

The search for food or new squares is the principal agency leading to the migration of the weevils from one place to another. Prevailing winds may assist if these occur when the weevils are naturally most active, as does the wind in Texas.

Artificial dissemination will take place most commonly along railways and water courses. The shipment of cotton baled or for ginning is nearly certain to mean the movement of the boll weevil. And the same is true of shipments of seed for planting and other purposes. Our State law already quoted (page 93) should receive the support of every person living in the State and having the slightest concern for the welfare of the State. In regard to pests of this and all other types legislative enactment may develop public sentiment, but certainly can never replace it.

### METHODS OF CONTROL.

The methods of control may roughly be divided into two classes (a) natural, and (b) artificial.



Among the first group we mention in the first place climatic control. The factors of highest importance in determining the development, distribution and destructiveness of the boll weevil are temperature, precipitation and food supply. We have stated that the weevil has but a single food plant—the cotton—and it is remarkable how thoroughly adjusted to the conditions of the food plant the weevil has become. Conditions favoring the growth of the cotton plant are also favorable to the development of the weevil.

High temperatures and abundant rainfall are the two climatic factors distinctly favorable to weevil development, and hence it is that at such times their injury is most noticeable. Rains tend to increase formation of squares by the cotton plant and the squares, we have seen, are the feeding places and oviposition structures for the weevils. Rains also indirectly favor weevil development by the injury they do to the natural enemies of the weevil.

Too heavy rains during the winter are very apt to kill many of the hibernating weevils and hence following a comparatively dry winter one would expect to see a larger brood of hibernated adult weevils appear in the spring than following a rainy winter.

Experiments have shown that overflows will not injure enough weevils to be of any great service. Even the larvae and pupae in squares that have been under water for some time were found to be uninjured. Adult weevils may float several days in the water and yet not be injured. It is very probable that the floating of adult and infested squares by means of high water will prove one of the most important natural agencies for widely distributing the pest.

#### PARASITES, PREDATORY INSECTS, AND DISEASES.

The very recent announcement by an officer of the United States Department of Agriculture of the discovery in Guatemala of an ant that preys upon the boll weevil has called forth renewed interest in this subject of parasites or rather predatory insects. However,

seems certain that the ant discovery has already been overworked and its importance much exaggerated. Hunter & Hinds, 1904, say: "There is at present, therefore, no promise of any considerable assistance in the control of the weevil by any parasite now known. \* \* \* Even should one be found which could check the weevil in some stage, it would probably still not be an efficient means of control. \* \* \*"

Obtain predatory insects other than the Guatemalan may serve to check the weevil, but the work of all insects combined is comparatively of little importance when compared with the cultural methods mentioned above.

And there seems to be but little hope of securing a parasite that will be of any service in killing weevils. A study of the history and outcome of the use of the "chinch bug" fungus and later the grasshopper locust shows how utterly impracticable any such method is certain to be.

In connection with the appearance of such an important pest as the boll weevil there is certain to be a host of remedial and preventive measures suggested. It would be a waste of space to even mention all these measures here. Considerable attention has been devoted to devising some method of spraying the cotton plants in order to kill the weevils. We may for the present discuss any spraying scheme with a quotation from Hunter and Hinds, 1904, who say: "Spraying of a field crop has not yet been a success, and, unless entirely new methods are eventually perfected, never will be of any practical importance."

In the course the suggestion made from time to time that the insecticide substance may be mixed with the fertilizer which is absorbed by the weevil is distasteful to the weevil when absorbed by the plant is absurd.

It has proven impossible to devise a machine that will enable one to collect from the ground the fallen squares. And it is even more absurd to hope to find any sort of insect that the boll weevil will not care to eat. There is no doubt as to the profitable variation in the cotton plant produced by breeding and selection and there is cer-

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tainly no hope of securing a strain of upland cotton will prove resistant to the boll weevil, or to any other insect.

#### CULTURAL METHODS.

It has been demonstrated that improved methods of cultivation will enable one and does enable many planters now to grow cotton at a fair profit in infested areas. If the weevil can force cotton planters throughout the cotton belt to adopt more civilized modern methods of cultivation we may be forced upon the weevil as a "blessing in disguise."

It is impossible better to present the desirability and certainty of results from the cultivation methods recommended by the Division of Entomology, United States Department of Agriculture, than to quote the recommendations given by W. D. Hunter, the agent in charge of the cotton boll weevil investigation.

"1. Plant early. If possible plant seed of early varieties known to mature early, or at least obtain seed from as far north as possible. It is much better to take the risk of replanting, which is not an expensive operation, than to have the crop delayed. The practice of some planters of making two plantings to avoid the risk of a late planting is all the work of chopping thrown into a short period, and is a very bad policy from the weevil standpoint.

Under identical conditions early cotton if planted in early varieties has invariably yielded from two to three times as much as native cotton under the same conditions, and in many cases much more. Planted at the same time the early varieties begin to bloom from twelve to twenty days sooner than native cotton.

Early planted fields of either native or improved varieties have almost invariably yielded twice as much as late planted ones.

The early varieties in general, having a small tap root and a short tap root, are adapted only for rich soil. They also fail to grow well in the very light sandy loam of many of the river valleys of Texas which, in former seasons before the advent of the boll-weevil, often produced the largest yields. In these situations early varieties

will yield but little more than native cotton.

2. Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting, the best course for the planter to pursue is to cultivate the fields in the most thorough manner possible. Three choppings and five plowings constitute as thorough a system of cultivation as is necessary in cases where the land has previously been kept reasonably clear.

3. Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. On land which in normal seasons will produce from 35 to 40 bushels of corn the rows should be 5 feet apart. Even on poor soil it is doubtful if the distance should ever be less than 4 feet.

4. Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as the weevils become so numerous that practically all the fruit is being punctured. This will generally not be later than the first week in October. Merely cutting off the stalks by means of the triangular implement used for that purpose throughout the south is by no means as effective as plowing, because the stumps remaining give rise to sprouts which furnish food until late in the season to many weevils that would otherwise starve. The plowing, moreover, serves to place the ground in better condition for early planting the following spring. In some cases turning cattle into the fields is advisable. Aside from amounting to a practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand. Nevertheless, cattle should never be turned into cotton fields in which Johnson grass has become started.

5. It is known that at present fertilizers are not used to any considerable extent in cotton producing in Texas. There is, nevertheless, no doubt that they should be; not that the land is poor, but that earlier

crops may be procured. At present it is sufficient to draw attention to the fact that it has been the uniform experience of experiment stations and planters in the eastern part of the belt that certain fertilizers, especially those involving a large percentage of phosphoric acid, have a strong tendency towards hastening the maturing of the plants."

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**ALABAMA**

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**Agricultural Experiment Station**

OF THE

**Alabama Polytechnic Institute**

**AUBURN**

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**Tests of Varieties of Cotton**

**IN 1904**

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By

**J. F. DUGCAR**

**Director and Agriculturist.**

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**Opelika, Ala.:**

**The Post Publishing Company.**  
**1905.**

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## VARIETY TESTS OF COTTON IN 1904.

BY J. F. DUGGAR.

The season of 1904 presented some trying conditions for cotton plant. The rainfall for March was below normal. April was exceedingly dry and the drought was not broken until late in May. The total rainfall for March was .45 inches; for April 1.02 inches; and for the first four days in May, less than .75 of an inch. These conditions existed in stands by no means as uniform as is desirable in experimental work.\*

The wet weather of July and the heavy rains of the latter part of August resulted in a vigorous growth of the cotton plant and a promise of a large crop. From the latter part of August until the date of the first light frost there was practically no rain. At Auburn the rainfall for September was only .26 of an inch; for October .02, and for November 2.28 inches.

The extreme of wet weather in August, followed by very dry weather in September, resulted in the shedding of an unusually large proportion of forms. The shedding of forms in different varieties, and under different conditions, has been the subject of a co-operative investigation both at Auburn and in Montgomery county begun jointly in 1904 between this station and the Division of Vegetable Pathology and Physiological Investigations of the United States Department of Agriculture. Of course a repetition of that

The writer desires to express here his grateful appreciation of the valuable assistance in these experiments afforded by Dr. J. T. Herson, who furnished the rainfall record; Mr. C. M. Floyd, who was in charge of the field work at Auburn; Mr. C. H. Billingsley, of the United States Department of Agriculture, who furnished the data for indicating the relative earliness of varieties, and to Mr. C. Hudson, who is responsible for most of the calculations.



experiment for several seasons will be needed before conclusive data for publication can be expected.

A light frost occurred late in October and the first killing frost occurred November 14, the latter killing a number of small bolls.

#### YIELDS OF VARIETIES IN PLOTS AT AUBURN.

The field on which these tests were made is known as the ten-acre field. It has a reddish loam soil with a considerable proportion of flinty stones. It is regarded as upland of somewhat better than average quality because of the occasional growing of a crop of cow peas for hay. Every fifth plot throughout most of the field was planted with the Culpepper variety to ascertain if there were any decided inequalities in the fertility of the land.

The land was plowed broadcast with a two-horse plow late in March, and bedded and fertilized just before planting, which occurred April 20th.

The fertilizer per acre consisted of:

- 64 lbs. nitrate of soda.
- 120 lbs. cotton seed meal.
- 240 lbs. acid phosphate.
- 64 lbs. muriate of potash.

---

488 lbs., total per acre.

For three or four weeks after planting only an occasional seed sprouted, the ground being loose and very dry. Then a roller was run over the field to press the seed into closer contact with the soil, and this was immediately followed by the weeder, a light form of harrow, used to check evaporation. Within a week, and as a result of this rolling and harrowing, a fairly good stand of cotton was in sight, although the weather continued very dry. The plants were so thinned that they averaged, on the plots with perfect stands 18 1-2 inches apart with rows 3 1-2 feet wide. Only one variety, Gold Standard, had such a poor stand as to seri-

ously affect its yield and to necessitate its exclusion from the following table. A careful study of the detailed records led to the conclusion that the yields were not materially affected by the slight deficiencies in stand, though it is possible that the varieties Doughty, with 76 per cent. of a stand, Texas Burr, with 84 per cent., and Truitt, with 86 per cent., might have stood a few points higher if the stand had been perfect. It was concluded that any effort to calculate the probable yields with perfect stands, would, in this case, involve a greater error than is incurred in giving the actual yields without this correction for slight deficiencies in stand.

The following table gives the actual yield of seed cotton, lint, and seed, all these weights being taken at the gin house a number of weeks after the two heaviest pickings had been made, thus permitting all varieties to dry out to a somewhat uniform degree. In the same table are two columns giving the value of the total product of seed and lint per acre, based, in one column, on a price of ten cents per pound for lint, and in the other column on a price of seven cents per pound, the seed in both columns being valued at seventy cents per 100 pounds. These may be called high and low prices. Readers who prefer other prices can substitute their own figures and make their own calculations.

*Yields of lint and seed of 38 varieties of cotton on  
Farm at Auburn in 1904 and value of the crop per*

Rank in value of product	VARIETY.	Stand of plants	Actual yield per acre of			Value of seed and lint per acre for lint & seed
			Seed cotton	Lint	Seed	
		%	Lbs.	Lbs.	Lbs.	\$
1	Peterkin	100	1624	628	993	69.
2	Layton Improved	92	1632	620	1011	69.
3	Jackson	100	1584	607	974	67.
4	Alex. Allen	92	1673	581	1088	65.
5	Wise	94	1481	556	905	61.
6	Cameron Early	100	1558	546	1009	61.
7	Simms Long Staple	100	1675	539	1065	61.
8	Pullnot	97	1542	543	963	61.
9	Cook Improved	100	1403	548	852	60.
10	Doughty Improved	76	1336	522	997	59.
11	Allen Long Staple	94	1610	498	1120	57.
12	Culpepper	96	1486	508	965	57.
13	Texas Burr	84	1488	502	980	57.
14	Willett Red Leaf	95	1352	503	840	56.
15	Hawkins	100	1332	487	839	54.
16	King	100	1396	484	861	54.
17	(Lewis) Prize	92	1297	486	804	54.
18	Russell	100	1431	473	952	53.
19	Nancy Hanks	98	1401	474	916	53.
20	Drake	100	1412	467	942	53.
21	Mascot	100	1292	476	811	53.
22	Shine	94	1368	465	895	52.
23	Sam Woodfin Prolific	97	1400	463	924	52.
24	Jones Improved	100	1392	462	927	52.
25	Truitt	86	1348	462	872	52.
26	Schley	100	1324	457	862	51.
27	Grier's King	96	1248	459	774	51.
28	Edgeworth	100	1288	453	829	51.
29	Garrard	89	1225	453	765	50.
30	Johnson's Excelsior	100	1230	442	785	49.
31	Pride of Georgia	100	1276	436	839	49.
32	Meredith	92	1288	434	846	49.
33	Mortgage Lifter	100	1288	433	841	49.
34	Floradora	100	1296	420	875	48.
35	Parker	100	1196	408	785	46.
36	Blue Ribbon (fuzzy seed)	100	1225	401	813	45.
37	Sunflower	100	1228	401	812	45.
38	Blue Ribbon (black seed)	100	1203	379	818	43.
38	Lealand	95	1144	378	765	43.

\*Seed 70 cents per 100 lbs. or \$14.00 per ton.

The largest yield was made by Peterkin, closely followed by Layton, Jackson and Alex. Allen. Wise occupies fifth place.

Grouping together such of the varieties as the writer has up to this time definitely classified in accordance with the classification outlined by him in Bulletin No. 107 of the Alabama Experiment Station, and neglecting groups of varieties having few representatives in this test, we have average results that are significant, as below:

*Average yields of Classes of varieties at Auburn in 1911*

	Lint per acre	Seed per acre	Value per acre at 10c and \$14.00
<b>Semi-Cluster Group</b>		<i>Lbs.</i>	
Hawkins .....	487	839	\$54.54
Drake .....	467	942	53.29
Woodfin .....	463	924	52.76
Garrard .....	453	765	50.65
Average .....	468	867	\$52.81
<b>Peterkin Type.</b>			
Peterkin .....	628	993	\$69.75
Layton .....	620	1011	69.07
Wise .....	556	905	61.93
Average .....	601	936	\$66.91
<b>King Type.</b>			
King .....	484	861	\$54.42
Mascot .....	477	811	53.27
Shine .....	465	895	52.76
Grier's King .....	459	774	51.31
Average .....	471	835	\$52.94
<b>Big Boll Type.</b>			
Culpepper .....	508	965	\$57.56
Texas Burr .....	502	980	57.06
Russell .....	473	952	53.96
Jones Improved .....	462	927	52.68
Truitt .....	462	872	52.30
Schley .....	457	862	51.73
Pride of Georgia .....	436	839	49.47
Mortgage Lifter .....	433	841	49.18
Average .....	466	905	\$54.79
<b>Long Staple Group.</b>			
Floradora .....	420	875	\$48.12
Sunflower .....	401	812	45.78
Blue Ribbon (fuzzy seed) .....	401	813	45.79
Blue Ribbon (black seed) .....	379	818	43.62
Average .....	400	829	\$46.08

From the above table it will be seen that the Peterkin and varieties having similar qualities were decidedly in the lead at Auburn in 1904 in the production of lint. Taking the yield of lint made by the Peterkin group as 100, we find that the average relative yield of the semi-cluster group may be represented by 78; of the King type by 78; of the big boll group by 77; and of the long staple group by 66. This throws some light on the question of the difference in productiveness on upland soils of the long staple varieties as compared with the other groups. The varieties Allen long staple and Simms long staple are not included in this average for the reason that they grew on the lowest, and doubtless the richest, plots in the field.

The local markets usually pay little or no premium for the long staple varieties, which, however, command a premium of several cents a pound in the larger southern seaport markets. This year at Auburn for the four long staple varieties to have nearly equaled the Peterkin group in value per acre it would have been necessary for long staple lint to sell for 15 cents per pound when Peterkin was 10 cents, or for 10 1-2 cents when Peterkin was worth 7 cents. If we compare the long staple with either of the other groups a much smaller premium would equalize the values. Long staple cotton should have rich bottom land for its best development.

While the Peterkin group is ahead this year, it by no means follows that it will maintain its lead when seasonal conditions and soils are different.

#### PER CENT. OF LINT IN VARIETIES TESTED IN PLOTS AT AUBURN IN 1904.

During a study of cotton varieties extending over a number of years a large amount of data have been obtained regarding the proportions of seed and lint of 175 or more varieties which have recently been grown. The following table gives only so much of this data as was obtained in 1904.

by ginning the cotton on these plots of which the yield is reported in the first table of this bulletin.

*Per cent of lint in plot tests at Auburn in 1904*

<i>Variety</i>	<i>Per Cent Lint</i>	<i>Variety.</i>
1 Cook Improved .....	39.1	Parker .....
2 Gold Standard .....	38.9	Doughty .....
3 Peterkin .....	38.7	Pride of Georgia .....
4 Jackson .....	38.3	Shine .....
5 Wise .....	37.6	Nancy Hanks .....
6 Prize .....	37.4	Meredith .....
7 Willett Red Leaf .....	37.2	Texas Burr .....
8 Garrard .....	37.0	Mortgage Lifter .....
9 Grier's King .....	36.8	Jones Improved .....
10 Mascot .....	36.8	Sunflower .....
11 Hawkins .....	36.5	Drake .....
12 Johnson's Excelsior ..	36.0	Russell .....
13 King .....	35.9	Lealand .....
14 Alex. Allen .....	35.3	Sam Woodfin Prolific ..
15 Edgeworth .....	35.2	Blue Ribbon (fuzzy seed)
16 Pullnot .....	35.2	Floradora .....
17 Cameron Early .....	35.0	Simms Long Staple .....
18 Schley .....	34.6	Blue Ribbon (black seed)
19 Culpepper .....	34.3	Allen Long Staple .....
20 Truitt .....	34.3	

It will be noted that the proportion of lint to seed is unusually high. This was also the case in the varieties tested at the Georgia station in 1904, as indicated in a recent paper article by Director R. J. Redding. This comparison of results suggests that something in the climatic conditions of 1904 was favorable to the increase of lint or to the decrease of seed.

It will be noted that the long staple varieties have lower percentages of lint than most of the short staple varieties.

**VARIETY TESTS ON PRAIRIE SOIL IN MONTGOMERY COUNTY  
1904.**

Through co-operation with the United States Department of Agriculture as before stated, we are this year ena-

print the results of a variety test made on the A. H. Clarke plantation about half a mile northeast of the depot at McGehee's Switch station, Montgomery county.

The soil is gray prairie upland of about average quality, not recently fertilized, so far as is known, until the present year. Planting was done April 29-30. On June 1, fertilizers as below were applied on the side of the row in the shallow furrow made by the first cultivation. The fertilizer was then covered by the throwing out of the middles. The fertilizer used consisted of:

200 lbs. acid phosphate per acre.

200 lbs. kainit per acre.

100 lbs. nitrate soda per acre.

This date of application was doubtless too late for good results for this season and on this soil, as shown not only in variety tests, but in fertilizer tests on another part of the same field. Through a misunderstanding the plots were not thinned to a uniform stand, but it was found that the yield of three plots of Truitt did not vary greatly with variations in the stand. As it was impracticable to gin the seed cotton of each plot separately at McGehee's, the yield of lint is obtained by multiplying the weight of seed cotton by the per cent. of lint found in the variety test at Auburn in 1904.



*Yields of varieties of cotton at McGehee's Switch, Ala.,  
in 1904.*

Plot No.	Rank in value of products	VARIETY.	No of plants per acre.	Yield per acre.			*Value of seed and lint per acre. 10c for lint.	*Value of seed and lint per acre. 7c for lint.
				Seed cotton.	Lint	Seed.		
				<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>\$</i>	<i>\$</i>
18.	1	Schley .....	7070	830	287	543	32.50	23.89
14	2	Peterkin .....	6390	750	290	460	32.22	23.52
22	3	Drake .....	6500	690	228	360	31.23	24.39
23	4	Crossland .....	5750	770	277	493	31.15	22.94
17	5	Toole .....	6410	790	270	520	30.72	22.62
1	6	King .....	5630	730	262	468	29.47	21.61
21	7	Bancroft Herlong ...	6800	800	256	544	29.41	21.73
Av. 5, 10 and 15	8	Truitt .....	5947	746	256	492	29.03	21.35
20	9	Simms .....	7630	750	241	509	27.66	20.43
16	10	Floradora .....	6100	720	233	487	26.70	19.71
11	11	Hawkins .....	5910	620	226	394	25.35	18.57
2	12	Russell .....	5670	650	215	435	24.54	18.09
12	13	Cook Long Staple....	5830	680	207	473	24.05	17.84
19	14	Doughty Long Staple	6910	600	204	396	23.17	17.05
7	15	Jackson .....	5800	540	207	333	23.03	17.82
4	16	Parker .....	6000	560	190	370	21.59	15.89
3	17	Sunflower .....	6360	560	185	375	21.12	15.57
6	18	Pride of Georgia ...	5520	530	180	350	20.45	15.05
8	19	Mortgage Lifter .....	5000	500	167	333	19.03	14.02
13	20	Allen Long Staple ..	6040	500	154	346	17.82	13.20

\*Seed valued at 70 cents per 100 pounds or \$14.00 per ton.

The varieties affording the largest value of seed and lint were Schley and Peterkin, closely followed by Drake and Crossland. Toole stands fifth. In this test, as at Auburn, the varieties of the Peterkin type, namely, Peterkin and Crossland stand well to the front with an average yield of 283 1-2 pounds of lint per acre. Taking this yield of lint as 100 per cent., the groups of varieties hitherto classified average as follows:

Peterkin group (Peterkin and Crossland)..... 100.  
Big boll group (Russell, Schley, Truitt, Pride of Georgia, and Mortgage Lifter) ..... 78.

Semi-cluster group (Hawkins and Drake) .....	69.
Long staple group (Floradora, Cook, Long Staple, Doughty, Sunflower, and Allen long staple) .....	69.

#### RELATIVE EARLINESS OF VARIETIES.

The invasion of the cotton states by the cotton boll weevil renders more important than ever before careful studies of the early varieties. It has been found that only the earliest varieties can be profitably grown in infested regions, even when all other known methods of combatting the weevil are employed.

The rapid spread of the weevil eastward in Louisiana during the past season makes it important that the farmers of Alabama should be ready for this invasion as promptly as possible. It would be well for every neighborhood, and perhaps for every farm, to have at least a small portion of its crop in one of the very early varieties so that seed of early varieties may be everywhere available when urgently needed.

It is easy to determine at a glance that one variety is early and another late, but it is less easy to indicate the relative earliness of intermediate varieties. In the two tables which follow the figures show how many bolls had opened on a given date early in September out of every 100 bolls maturing during the entire season.

These figures are based on counts of bolls on five selected plants of each variety made by Mr. C. H. Billingsley, of the United States Department of Agriculture.

*Relative earliness of varieties at Auburn in 1904, as shown by per cent of bolls open on September 1 on counted plants.*

<i>Variety.</i>	<i>Per cent bolls open Sept. 1</i>	<i>Variety.</i>	<i>Per cent bolls open Sept. 1</i>
King .....	82	Jones Improved .....	28
Mascot .....	77	Schley .....	19
Meredith .....	49	Sunflower .....	19
Garrard .....	47	Gold Standard .....	19
Grier's King .....	46	Parker .....	18
Lealand .....	44	Blue Ribbon (wooly seed) .....	17
Nancy Hanks .....	44	Alex. Allen .....	16
Shine .....	42	Woodfin .....	16
Jackson .....	41	Culpepper .....	15
Hawkins .....	35	Blue Ribbon (black seed) .....	15
Layton .....	34	Peterkin .....	15
Johnson Excelsior .....	33	Doughty .....	14
Edgeworth .....	32	Russell .....	14
Texas Burr .....	32	Pullnot .....	14
Pride of Georgia .....	31	Floradora .....	14
Cameron Early .....	31	Mortgage Lifter .....	13
Cook Improved .....	30	Simms Long Staple .....	13
Drake .....	25	Allen Long Staple .....	12
Wise .....	22	Truitt .....	10
Prize .....	21	Cook Long Staple .....	7
		Willett Red Leaf .....	6

*Relative earliness of varieties at McGehee's as shown by per cent of bolls open on September 7, 1904.*

<i>Variety.</i>	<i>Per cent bolls open Sept. 7</i>	<i>Variety.</i>	<i>Per cent bolls open Sept. 7</i>
Toole .....	91	Truitt .....	23
King .....	66	Crossland .....	23
Simms .....	39	Pride of Georgia .....	23
Mortgage Lifter .....	33	Cook Long Staple .....	18
Allen Long Staple .....	32	Peterkin .....	17
Sunflower .....	27	Floradora .....	15
Jackson .....	27	Doughty .....	14
Parker .....	25	Hawkins .....	13
Russell .....	25	Drake .....	12
Schley .....	24	Bancroft .....	7

The above tables are based on careful counts made on plants of each variety. Since individual peculiarities of these plants have greatly affected the positions in the table, it is in place to say that judging only by the actual appearance of the plots the varieties matured more together than indicated by the table and at Auburn following varieties especially appeared earlier than is stated by their positions in the tables: Alex. Allen, Woodfin, and Culpepper.

#### WHERE TO GET SEED.

The experiment station is unable to supply seed of any of these varieties. In order to enable farmers to obtain any of such of these varieties as they desire, addresses are given below of parties from whom our seed were obtained in 1904:

Culpepper from J. E. Culpepper, Luthersville, Ga.  
 Drake from R. W. Drake, Laneville, Ala.  
 Cook Improved from J. R. Cook, Schley, Ga.  
 McGeworth from J. C. Little, Louisville, Ga.  
 The Ribbon from S. C. Experiment Station, Clemson College, S. C.  
 Old Standard from Excelsior Seed Farm, Bennettsville, S. C.  
 S. V. Woodfin Prolific from S. V. Woodfin, Marion, Ala.  
 Parker, Sunflower, Russell, Mortgage Lifter, King and Queen from United States Department of Agriculture, Washington, D. C.  
 Pruitt and Peterkin from Harvey Seed Co., Montgomery, Ala.  
 Wmms, Allen Long Staple, Willett Red Leaf, Doughty Long Staple, Cook Long Staple, Floradora, Hawkins, Jones Improved and Schley from N. L. Willett Drug Co., Augusta, Ga.  
 Side of Georgia, Cameron Early, Layton Improved, Merriam, Nancy Hanks, Garrard, Grier's King, Mascot, Shine,

Texas Burr, Prize, Wise, Alex. Allen, and Pullnot  
Georgia Experiment Station, Experiment, Ga.

Lealand from H. P. Jones, Herndon, Ga.

Johnson Excelsior from C. R. Baird & Co., Chat-  
Tenn.

#### OTHER EXPERIMENTS IN PROGRESS WITH VARIETIES OF

This bulletin relates to only about half of the  
grown on the experiment station farm at Auburn.  
The space available was not sufficient for the re-  
varieties to be grown on areas large enough to affor-  
rate determinations of the yields.

The remaining varieties, grown on very small a-  
well as the varieties here reported, constitute part o-  
periment, the main object of which is to obtain  
descriptions and photographs of every variety ob-  
east of the boll weevil region. It will require  
another year before results can be published; meant  
experiment will be continued in 1905, and for use  
experiment the writer will be glad to obtain by m-  
growers or originators small packages of seed of  
established variety which each is growing. The ser-  
requested to exercise care in fully labeling the pac-  
the outside, giving the name and postoffice of the se-  
the true establishel name of the variety.

Our thanks are hereby extended to all of those w-  
past few years have furnished small lots of seed  
experiment. I would repeat here the statement  
have made every spring in the circular letters sent  
ers. *From the nature of the experiment no repor-*  
*made by letter as to how any variety stands.* Ho-  
is the intention to send to each contributor of see-  
of the bulletin that will be published when the inve-  
is completed.



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**BULLETIN NO. 131.**

**FEBRUARY, 1905.**

**ALABAMA**

# **Agricultural Experiment Station**

**OF THE**

**Alabama Polytechnic Institute,**

**AUBURN.**

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**Co-operative Fertilizer Experiments With Cotton**

**IN 1901, 1902, 1903, AND 1904.**

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**By**

**J. F. DUGGAR,**

**Director and Agriculturist.**

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**Opelika, Ala.:**  
**The Post Publishing Company.**  
**1905.**

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The Bulletins of this Station will be sent free to any c  
the State on application to the Agricultural Experiment  
Auburn, Alabama.

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## CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1901, 1902, 1903, AND 1904.

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BY J. F. DUGGAR.

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*A brief summary of the average results of these experiments may be found on page 67.*

For a number of years this station has conducted numerous local fertilizer experiments, furnishing material and instructions to farmers agreeing to make the tests.

The number of local fertilizer experiments with cotton, of which reports were received, was as follows: In 1901, ten; in 1902, thirteen; in 1903, ten, and in 1904, twenty-one. This does not include a number of experiments that were made, but of which the experimenters made no reports or reported accidental loss of results. In all of these years fertilizer experiments were also made on corn and other crops, the results of which will be published in future years.

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of Alabama.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.



The following list gives the name and address of experimenter who has reported the results of fertilizer experiments made under our direction during the last four years with page of this bulletin where the results may be found.

COUNTY.	POST OFFICE.	NAME.	DATE.
Burbour	Louisville	J. D. Veal	1904
Bibb	Vick	W. T. Chism	1901, '2, '3
Blount	Tidmore	Jno. W. Staab	1901
Bullock	Union Sp'gs.	N. Gachet	1904
Butler	Garland	G. L. McLure	1901
Butler	Greenville	D. H. Rcuse	1901
Butler	Georgiana	J. C. Lee	1904
Chambers	Fredonia	E. W. Smartt	1904
Chilton	Clanton	W. A. Chandler	1904
Choctaw	Naheola	W. G. Bevill	1901, '02
Coffee	Enterprise	C. A. Hatcher	1904
Conecuh	Evergreen	J. W. Stewart	1902
Coosa	Hanover	J. M. Logan	1902, '03
Cullman	Cullman	L. A. Fealy	1903
Dale	Midland City	W. H. Simmons	1904
DeKalb	Collinsville	W. F. Fulton	1902, '3
Elmore	Wetumpka	5th Dist. Agr. School	1901, '2, '3
Elmore	Tallassee	J. D. Billingsley	1903
Fayette	Newtonville	G. W. Gravlee	1904
Franklin	Russellville	G. R. Pass	1904
Geneva	Geneva	M. P. Metcalf	1901, '2, '3, '4
Hale	Greensboro	T. K. Jones	1902, '4
Lauderdale	Florence	W. A. Parish	1904
Lawrence	Town Creek	A. A. Owens	1904
Lee	Auburn	Ala. Expt. Sta.	1902, '4
Limestone	Athens	P. G. Williams	1903
Macon	Notasulga	J. P. Slaton	1904
Madison	Huntsville	C. Davis	1901
Madison	Huntsville	H. D. N. Wales	1902, '3, '4
Marion	Hamilton	6th Dist. Agr. School	1903
Perry	Long	L. Long	1902
Pickens	Gordo	J. W. French	1901
Pickens	Gordo	D. W. Davis	1902
Shelby	Montevallo	J. W. Wyatt	1904
Talladega	Silver Run	C. L. Jenkins	1902, '3, '4
Tallapoosa	Camp Hill	Lyman Ward	1902
Tuscaloosa	Tuscaloosa	E. J. Daffin	1901
Washington	Carson	R. D. Palmer	1904

The directions sent required each plot to be one-eighth of an acre in area. Rows were 3 1-2 feet apart, and each experimenter was advised to so thin the cotton as to leave the same number of plants on each plot, preferable at distances of 18 inches between plants.

The directions stated that land employed for this test should be level and uniform, not manured in recent years, and not new ground, or subject to overflow, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of treatment for all plots (except as to kinds of fertilizers used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled.

#### THE RAINFALL.

The following data are taken from the records of the Alabama section of the Weather Bureau and show the average rainfall for the State:

	INCHES RAINFALL.				
	1901	1902	1903	1904	
January .....	5.32	3.86	3.56	4.17	.....
February .....	4.13	6.52	10.95	3.80	.....
March .....	6.30	8.76	5.91	3.69	.....
April .....	5.27	2.34	2.72	2.22	.....
May .....	5.08	2.34	6.05	2.98	.....
June .....	2.80	1.28	4.88	2.94	.....
July .....	3.40	2.50	3.98	4.80	.....
August .....	8.86	3.48	3.57	5.55	.....
September .....	4.19	4.28	1.41	1.36	.....
October .....	1.04	3.58	1.82	0.34	.....
November .....	1.85	4.22	2.12	2.98	.....
December .....	7.80	5.77	2.93	4.38	.....
Average .....	55.97	49.09	50.22	39.21	.....
Average yearly normal .....					51

In the summer of 1902 occurred a drought of unprecedented duration. This was general and in many localities there was little or no rain from April to August. Hence results of that year should be given less weight than those for the other years. In 1904 there was a deficiency of rain in spring and an injurious drought beginning about the middle of August.

### THE FERTILIZERS USED.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available)	\$14.00
Cotton seed meal .....	22.00
Kainit .....	15.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above.

In each experiment two plots were left unfertilized, these being plots 3 and 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos:

*Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.*

Plot No.	FERTILIZERS.		MIXTURE CONTAINS			COST OF FERTILIZERS	
	Amount per acre.	KIND.	Nitrogen.	†Available phosphoric acid.	Potash.	Per ton.	Per acre.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>		
1	200	Cotton seed meal .....	13.58	5.76	3.54	\$22.00	\$2.20
		<i>In 100 lbs. c. s meal.*</i>	<b>6.79</b>	<b>2.88</b>	<b>1.77</b>		
2	240	Acid phosphate .....		36.12		14.00	1.68
		<i>In 100 lbs. acid phos.</i>		<b>15.05</b>			
4	200	Kainit .....			24.60	15.00	1.50
		<i>In 100 lbs. kainit.</i>			<b>12.30</b>		
5 {	200	Cotton seed meal ... }	13.58	41.88	3.54	17.63	3.88
	240	Acid phosphate .....					
		<i>In 100 lbs. above mixt.</i>	<b>3.09</b>	<b>9.52</b>	<b>.80</b>		
6 {	200	Cotton seed meal ... }	13.58	5.76	28.14	17.50	3.70
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	<b>3.39</b>	<b>1.44</b>	<b>7.03</b>		
7 {	240	Acid phosphate .....				14.45	3.18
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>		<b>8.21</b>	<b>5.59</b>		
9 {	200	Cotton seed meal ... }	13.58	41.88	28.14	16.81	5.38
	240	Acid phosphate .....					
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	<b>2.12</b>	<b>6.54</b>	<b>4.39</b>		
10 {	200	Cotton seed meal ... }	13.58	41.88	15.84	17.15	4.65
	240	Acid phosphate .....					
	100	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	<b>2.59</b>	<b>7.75</b>	<b>2.93</b>		

\*Average of many analysis.

†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by  $1\frac{3}{14}$ .

In determining the increase over the unfertilized the yield of the fertilized plots, Nos. 4, 5, 6 and 7, compared with both unfertilized plots, lying on either side of each fertilized plot, a weight inversely proportional to its distance from the plot under comparison. This method of comparison tends to compensate for variations in the fertility of the several plots.

#### PRICE ASSUMED FOR SEED COTTON.

The price assumed is 8 cents per pound for lint and 10 cents per ton for seed. Deduct from this the cost of picking and ginning,  $\frac{1}{2}$  cent per pound of seed cotton, and we have 7 ½ cents as the *net* value per pound of increase of seed cotton. This last figure is used in all calculations of profits in this bulletin.

#### Huntsville experiments with cotton.

Plot No.	Amount per acre.	FERTILIZER.	HUNTSVILLE (Davis) 1901		HUNTSVILLE (Wales) 1902		HUNTSVILLE (Wales) 1903	
			Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
			Lbs.		Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	332	96	416	56	640	216
2	240	Acid phosphate	524	96	384	24	712	288
3	00	No fertilizer	428		360		424	
4	200	Kainit	512	78	353	00	600	192
5	200	Cotton seed meal	502	154	384	37	712	320
6	240	Acid phosphate	420	22	408	67	656	280
7	200	Cotton seed meal	616	169	368	33	552	192
8	240	Acid phosphate	452		328		344	
9	200	Kainit	792	340	416	88	648	304
10	200	Cotton seed meal	880	428	448	120	594	250
	100	Kainit						

PERIMENT MADE IN 1901 BY CLARENDON DAVIS, HUNTSVILLE.

*On upland soil and subsoil, characteristic of the Tennessee valley.*

This field had been in cultivation for many years. The preceding crop was wheat, itself preceded by cowpeas. Excessive shedding of forms, due to continued heavy rains in August, and the occurrence of light but damaging frost September 18th, reduced the yield on all plots, but more so on the plots fertilized heavily and on those receiving cotton seed meal. The early frost and the residual fertilizing effects of the cowpeas probably explain the slight effects of cotton seed meal, to which in combination with acid phosphate, cotton usually responds profitably on this grade of soil. For yield of seed cotton see page 24. That table shows that the increase in seed cotton per acre was as follows:

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	—96 lbs.
To acid phosphate plot .....	58 lbs.
To kainit plot .....	—100 lbs.
To acid phosphate and kainit plot.....	171 lbs.

Average increase with cotton seed meal..... 8 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	96 lbs.
To cotton seed meal plot .....	250 lbs.
To kainit plot .....	91 lbs.
To cotton seed meal and kainit plot .....	362 lbs.

Average increase with acid phosphate ..... 199 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	78 lb.
To cotton seed meal plot .....	74 lb.
To acid phosphate plot .....	73 lb.
To cotton seed meal and acid phosphate plot.....	186 lb.

---

Average increase with kainit .....102 lb.

The chief need of cotton on this soil was for acid phosphate. Although there was no rust, the addition of to the phosphate was profitable. The conditions in test did not give to cotton seed meal a fair opportunity to show the favorable effects that may usually be expected on this soil. Yet a complete fertilizer was the most profitable, plot 10 leading with a net profit of \$6.90 per acre after paying for fertilizers and for picking and ginning. The increase, on the basis of lint at 8 cents and cotton seed at 10 cents per hundred pounds.

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EXPERIMENTS MADE IN 1902, 1903, AND 1904 BY H. WALES, HUNTSVILLE.

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*Red clay soil and subsoil.*

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The excessively long dry period from April to August rendered all fertilizers ineffective in 1902. For yields and increase of crop see table on page 24. The 1903 experiment was preceded by two corn crops in succession. That year the largest yield resulted from the use of a mixture of acid phosphate and cotton seed meal. Kainit was of little use in combination, but on plot 4 it seemed useful when used alone. There was no rust. Mr. Wales thinks that early frost cut off one-half of the expected yields on plots 9 and 10, and did less injury on other plots.

In 1904 the experiment was on similar soil, that had borne a crop of cowpeas three years before and that had been uncultivated for two years. The largest yield was again obtained from plot 5, fertilized with 200 pounds

on seed meal and 240 pounds acid phosphate. Mr. [unclear] added an eleventh plot fertilized with 200 pounds [unclear] phosphate and 100 pounds cotton seed meal, the yield which was 684 pounds, or practically as good as plots 9, 10, containing kainit and a larger amount of cotton seed meal. Cotton seed meal was highly profitable when employed in combination, but less useful alone. Kainit is generally useless. In view of results recorded in this [unclear] and in those obtained in previous experiments on [unclear] red upland Tennessee valley soil, I would suggest as general fertilizer for cotton on that soil

to 120 lbs. cotton seed meal per acre.

to 240 lbs acid phosphate per acre.

to 360 lbs. total per acre.

If the cotton stalks grow very small it might be advisable to increase the proportion of cotton seed meal to one-half of the mixture.

Increase of seed cotton per acre when cotton seed meal was added:

	1902	1903	1904
unfertilized plot .....	56 lbs.	216 lbs.	64 lbs.
acid phosphate plot .....	13 lbs.	32 lbs.	405 lbs.
kainit plot .....	67 lbs.	88 lbs.	367 lbs.
acid phosphate and kainit plot.....	55 lbs.	112 lbs.	179 lbs.

Average increase with cotton seed meal.. 47 lbs. 112 lbs. 253 lbs.

Increase of seed cotton per acre when acid phosphate was added:

unfertilized plot .....	24 lbs.	288 lbs.	120 lbs.
cotton seed meal plot .....	—19 lbs.	104 lbs.	462 lbs.
kainit plot .....	—33 lbs.	0 lbs.	186 lbs.
cotton seed meal and kainit plot ....	21 lbs.	24 lbs.	—2 lbs.

Average increase with acid phosphate .. 14 lbs. 104 lbs. 167 lbs.



Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	0 lbs.	192 lbs.	—5 lbs.
To cotton seed meal plot .....	11 lbs.	64 lbs.	298 lbs.
To acid phosphate plot .....	9 lbs.	96 lbs.	61 lbs.
To cotton seed meal and phosphate plot	51 lbs.	16 lbs.	—160 lbs.
<hr/>			
Average increase with kainit .....	17 lbs.	92 lbs.	19 lbs.

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EXPERIMENTS MADE BY C. L. JENKINS, NEAR SILVER RUN,  
TALLADEGA COUNTY.

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*Most of the soil on this farm, six miles south of Oxford, is light reddish to yellowish loam, apparently fairly well supplied with lime.*

---

*In 1902.* The preceding crop was wheat. No cowpeas had been grown in recent years. The early part of the season was very dry. All three fertilizer materials were useful, a complete fertilizer giving the largest yield.

*In 1903.* The largest yield was obtained by the use of a complete fertilizer consisting of  
200 lbs. cotton seed meal per acre.  
240 lbs acid phosphate per acre.  
100 lbs kainit per acre.

---

*In 1904.* Again the largest yield was obtained by the complete formula just mentioned. Plot 5 this year, without kainit, yields almost as much as the plots with complete fertilizers. The first need of this soil seems to be for phosphate but nitrogen and potash were added with effect.

*Silver Run experiments with cotton.*

Plot No.	FERTILIZER.		SILVER RUN 1902		SILVER RUN 1903		SILVER RUN 1904	
	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots	Yield of seed cotton per acre.	Increase over unfertilized plots	Yield of seed cotton per acre.	Increase over unfertilized plots.
1	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
2	20	Cotton seed meal .....	144	40	200	80	576	48.
3	240	Acid phosphate .....	184	80	392	112	544	16.
4	0	No fertilizer .....	104		280		528	
5	200	Kainit .....	240	129	480	187	568	37
6	200	Cotton seed meal .....	324	207	672	366	880	345
7	240	Acid phosphate .....	356	233	568	249	696	158
8	200	Kainit .....	304	175	744	412	648	107
9	240	Acid phosphate .....	136		344		544	
10	200	No fertilizer .....	492	356	776	432	880	336
	200	Cotton seed meal .....	455	320	920	576	944	400
	240	Acid phosphate .....						
	100	Kainit .....						

Increase of seed cotton when cotton seed meal was added:

	1902	1903	1904
To unfertilized plot .....	40 lbs.	80 lbs.	48 lbs.
To acid phosphate plot .....	127 lbs.	254 lbs.	329 lbs.
To kainit plot .....	104 lbs.	62 lbs.	121 lbs.
To acid phosphate and kainit plot .....	181 lbs.	20 lbs.	229 lbs.

Average increase with cotton seed meal.. 95 lbs. 64 lbs. 181 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	80 lbs.	112 lbs.	16 lbs.
To cotton seed meal plot .....	167 lbs.	446 lbs.	297 lbs.
To kainit plot .....	46 lbs.	225 lbs.	70 lbs.
To cotton seed meal and kainit plot....	123 lbs.	183 lbs.	178 lbs.

Average increase with acid phosphate.. 106 lbs. 242 lbs. 140 lbs.

Increase of seed cotton per acre when kainit was added		
To unfertilized plot .....	129 lbs.	187 lbs.
To cotton seed meal plot .....	193 lbs.	329 lbs.
To acid phosphate plot .....	95 lbs.	300 lbs.
To cotton seed meal and acid phos. plot	149 lbs.	66 lbs.
<hr/>		
Average increase with kainit .....	141 lbs.	221 lbs.

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EXPERIMENTS MADE BY W. F. FULTON, ONE MILE SO  
COLLINSVILLE, DEKALB COUNTY.

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*Soil reddish or mullatto, subsoil red.*

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For table showing yields see page 31.

Both in 1902 and in 1903 the largest increase was from the use of cotton seed meal and acid phosphate together. Plainly kainit was not needed. Neither was seed meal alone, nor phosphate alone, sufficient. This was the fifth fertilizer experiment with cotton that Mr. Fulton has made on the red soils of Big Wills Valley, the Larimore and the later tests at Collinsville. Each time the description of the soil is about the same, reddish soil, underlaid by red clay, and all apparently calcareous. These tests all agree in showing:

- (1) That the chief need of cotton on this soil is for phosphate.
- (2) That the addition of cotton seed meal to the phosphate is profitable.
- (3) That in the presence of phosphate and meal kainit is useless.

The results suggest that the best fertilizer for the red soils is one containing more phosphate than meal. They suggest 200 pounds acid phosphate and 100 pounds cotton seed meal. Earlier results are recorded in bulletins 109 and 113 of this station. The following analysis shows the increase attributed to fertilizers in 1902 and 1903:

In none of the five experiments made by Mr. Fulton was there any injury by rust.

The average increase for the two years was on plot 5, receiving phosphate and meal, 348 pounds, affording a net profit per acre of \$5.77 after paying cost of fertilizer and of ginning and picking the increase.

*Collinsville and Montevallo experiments.*

Plot No.	FERTILIZER.		COLLINSVILLE 1902		COLLINSVILLE 1903		MONTEVALLO 1904	
	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal .....	440	144	376	48	1056	192
2	240	Acid phosphatæ .....	416	120	550	232	1000	146
3	00	No fertilizer .....	296		328		864	
4	200	Kainit .....	336	30	336	3	1056	144
5	200	Cotton seed meal .....	624	307	728	390	1072	112
6	240	Acid phosphatæ .....						
7	200	Cotton seed meal .....			528	185	1208	300
8	200	Kainit .....						
9	240	Acid phosphatæ .....	496	158	616	268	1384	328
10	200	Kainit .....						
	00	No fertilizer .....	348		352		1104	
	200	Cotton seed meal .....						
	240	Acid phosphatæ .....	544	196	712	360	1568	464
	200	Kainit .....						
	200	Cotton seed meal .....						
	240	Acid phosphatæ .....	512	164	712	360	1560	456
	100	Kainit .....						

Increase of seed cotton per acre when cotton seed meal was added:

	1902	1903
To unfertilized plot .....	144 lbs.	48 lbs.
To acid phosphate plot .....	187 lbs.	158 lbs.
To kainit plot .....	—	182 lbs.
To acid phosphate and kainit plot .....	38 lbs.	92 lbs.
Average increase with cotton seed meal .....	123 lbs.	120 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	120 lbs.	232 lbs..
To cotton seed meal plot .....	163 lbs.	342 lbs..
To kainit plot .....	128 lbs.	265 lbs..
To cotton seed meal and kainit plot .....	—	175 lbs..

Average increase with acid phosphate .....137 lbs. 253 lbs..

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	30 lbs.	3 lbs..
To cotton seed meal plot .....	—	137 lbs.
To acid phosphate plot .....	38 lbs.	36 lbs.
To cotton seed meal and acid phosphate plot ..	—111 lbs.	—31 lbs..

Average increase with kainit .....—14 lbs. 36 lbs..

EXPERIMENT MADE BY J. W. WYATT, FIVE MILES EAST OF  
MONTEVALLO, SHELBY COUNTY.

*Dark, reddish, sandy upland with red clay subsoil.*

This field had been cleared of its second growth of timber for about fifteen years, and for about ten years in succession had been planted in cotton.

The original growth is reported to have been oak, hickory, chestnut and dogwood, and the second growth springing up when the land was thrown out of cultivation after the civil war was short leaf pine and sumac. No mention is made of rust.

The complete fertilizer raised the yield to more than a bale per acre, an increase of 464 pounds. The complete fertilizer with 100 pounds of kainit was more profitable than the one with a larger amount of kainit, the former affording a profit of \$7.23 per acre after paying for fertilizer and picking and ginning of the increase..

increase of seed cotton when cotton seed meal was added:

To unfertilized plot .....	192 lbs.
To acid phosphate plot .....	—34 lbs.
To kainit plot .....	56 lbs.
To acid phosphate and kainit plot .....	136 lbs.

---

Average increase with cotton seed meal..... 87 lbs.

increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	146 lbs.
To cotton seed meal plot .....	—80 lbs.
To kainit plot .....	184 lbs.
To cotton seed meal and kainit plot.....	264 lbs.

---

Average increase with acid phosphate ..... 128 lbs.

increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	144 lbs.
To cotton seed meal plot .....	8 lbs.
To acid phosphate plot .....	182 lbs.
To cotton seed meal and acid phosphate plot.....	352 lbs.

---

Average increase with kainit ..... 171 lbs.

---

EXPERIMENT MADE BY G. R. PASS, RUSSELLVILLE, FRANKLIN  
COUNTY.

---

*test was made on dark reddish clay upland with clay  
subsoil.*

---

The original growth is described as oak and hickory with  
wild cherry and walnut. Unfortunately for showing  
full effects of cotton seed meal, the preceding crop was  
heavy, the entire growth being plowed under in the fall  
1903. The stand was good.

For yields and increase see table on page 36. The largest  
increase and the greatest profit per acre were obtained on plot  
where only cotton seed meal and acid phosphate were  
applied. With this fertilizer the increase was 595 pounds  
per acre and the net profit, after paying for fertilizer and

picking and ginning of increase, was \$11.59. Cotton meal was highly profitable in spite of the fact that the preceding pea crop had supplied a large amount of nit Kainit was useless, if not indeed injurious.

Increase of seed cotton when cotton seed meal was added

To unfertilized plot .....	448 lbs.
To acid phosphate plot .....	323 lbs.
To kainit plot .....	163 lbs.
To acid phosphate and kainit plot .....	142 lbs.

---

Average increase with cotton seed meal ..... 244 lbs.

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot .....	272 lbs.
To cotton seed meal plot .....	147 lbs.
To kainit plot .....	208 lbs.
To cotton seed meal and kainit plot .....	187 lbs.

---

Average increase with acid phosphate ..... 203 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	42 lbs.
To cotton seed meal plot .....	—243 lbs.
To acid phosphate plot .....	—22 lbs.
To cotton seed meal and acid phosphate plot .....	—203 lbs.

---

Average decrease with kainit ..... 106 lbs.

---

EXPERIMENT MADE BY L. LONG, LONG P. O., PERRY CO.  
IN 1902.

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*Worn red prairie with some sand.*

For yields and increase see table on page 36.

This soil had been uncultivated for several years, but borne two crops of cotton just before the experiment made. With a mixture of cotton seed meal and phosphate (plot 5) the increase was 360 pounds, affording a net of \$5.48 per acre. Acid phosphate seems to have been the fertilizer chiefly needed, and the addition of cotton

meal to the phosphate was highly profitable. Kainit was unprofitable.

These results suggest that a suitable fertilizer for this soil might well contain more phosphate than meal, say two-thirds acid phosphate and one-third cotton seed meal. Mr. Long added an additional plot fertilized only with four 2-horse loads unweighed stable manure per acre. From this the increase over the nearest unfertilized plot was 188 pounds of seed cotton per acre.

**Increase of seed cotton when cotton seed meal was added:**

To unfertilized plot .....	104 lbs.
To acid phosphate plot .....	64 lbs.
To kainit plot .....	144 lbs.
To acid phosphate and kainit plot .....	112 lbs.

---

**Average increase with cotton seed meal.....106 lbs.**

**Increase of seed cotton per acre when acid phosphate was added:**

To unfertilized plot .....	296 lbs.
To cotton seed meal plot .....	256 lbs.
To kainit plot .....	300 lbs.
To cotton seed meal and kainit plot.....	268 lbs.

---

**Average increase with acid phosphate .....278 lbs.**

**Increase of seed cotton per acre when kainit was added:**

To unfertilized plot .....	4 lbs.
To cotton seed meal plot .....	44 lbs.
To acid phosphate plot .....	8 lbs.
To cotton seed meal and acid phosphate plot..	56 lbs.

---

**Average increase with kainit ..... 28 lbs.**



## Russellville, Long, Tidmore and Cullman experiments

Plot No.	FERTILIZER.		RUSSEVILLE 1904		LONG 1902		TIDMORE 1901	
	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
1	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal .....	1112	448	296	104	32	32
2	240	Acid phosphate .....	936	272	488	296	52	232
3	00	No fertilizer .....	664		192		292	
4	200	Kainit .....	768	42	192	4	276	4
5	200	Cotton seed meal .....	1384	595	544	36	688	436
5	240	Acid phosphate .....						
6	200	Cotton seed meal .....	1056	205	328	148	488	256
6	200	Kainit .....						
7	240	Acid phosphate .....	1096	250	480	304	400	188
7	200	Kainit .....						
8	00	No fertilizer .....	976		172		192	
8	200	Cotton seed meal .....						
9	240	Acid phosphate .....	1368	392	588	416	752	560
9	200	Kainit .....						
10	200	Cotton seed meal .....	1424	448	468	296	796	604
10	240	Acid phosphate .....						
	100	Kainit .....						

EXPERIMENT MADE BY JNO. W. STAAB, TWO MILES, N. OF TIDMORE, BLOUNT COUNTY.

*Light, gray, sandy soil with red loam subsoil 4 to 6 feet below the surface.*

This upland field had been in cultivation about 20 years. The original growth is reported as shortleaf gum, mountain oak, persimmon, and hickory. All were thinned to the same number of plants. For yield increase see table on page 36. A complete fertilizer containing 100 pounds of kainit gave the largest increase a net profit of \$11.07 per acre. A mixture of cotton meal and phosphate was also highly profitable.

The conclusions drawn by Mr. Staab from this experiment and from previous experience are here quoted:

"1. That 50 to 100 pounds of fertilizer per acre is not sufficient to mature a full crop.

2. That even the heavy applications do not pay unless the ground contains considerable humus.

3. That phosphatic fertilizers in connection with cotton seed meal or cowpeas, or weeds turned under green will pay better than nine-tenths of the fertilizers commonly used.

4. That heavy applications help crops into quick germination and more rapid growth, lessening expense for weeding.

5. That a reduction of acreage and adequate increase of manures are advisable.

6. I do not find kainit of nearly the value it is advertised; in times of drought it shows for itself by the wilting of the foliage. This is ameliorated by a mixture of cotton seed meal and acid phosphate."

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	32 lbs.
To acid phosphate plot .....	204 lbs.
To kainit plot .....	252 lbs.
To acid phosphate and kainit plot .....	372 lbs.

---

Average increase with cotton seed meal .....

215 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	232 lbs.
To cotton seed meal plot .....	404 lbs.
To kainit plot .....	184 lbs.
To cotton seed meal and kainit plot .....	304 lbs.

---

Average increase with acid phosphate .....

282 lbs.

**Increase of seed cotton per acre when kainit was added**

To unfertilized plot .....	4 lb
To cotton seed meal plot .....	224 lb
To acid phosphate plot .....	—44 lb
To cotton seed meal and acid phosphate plot .....	124 lb

---

**Average increase with kainit .....** 77 lb

**EXPERIMENT MADE AT CULLMAN IN 1904.**

This experiment was conducted by Mr. Feirtag for A. Fealy. The land is described as very poor and as entirely fair. The soil is not described but was probably the characteristic sandy soil of that region. For yield increase see table on page 36. The largest increase in the greatest profit were obtained on plot 5 from a combination of acid phosphate and cotton seed meal, the net profit being \$7.43 per acre.

**Increase of seed cotton when cotton seed meal was added**

To unfertilized plot .....	104 lb
To acid phosphate plot .....	291 lb
To kainit plot .....	259 lb
To acid phosphate and kainit plot .....	66 lb

---

**Average increase with cotton seed meal .....** 180 lb

**Increase of seed cotton per acre when acid phosphate was added**

To unfertilized plot .....	144 lb
To cotton seed meal plot .....	331 lb
To kainit plot .....	212 lb
To cotton seed meal and kainit plot .....	19 lb

---

**Average increase with acid phosphate .....** 176 lb

**Increase of seed cotton per acre when kainit was added**

To unfertilized plot .....	82 lb
To cotton seed meal plot .....	237 lb
To acid phosphate plot .....	150 lb
To cotton seed meal and acid phosphate plot .....	—75 lb

---

**Average increase with kainit .....** 98 lb

EXPERIMENT MADE BY J. W. FRENCH, 3½ MILES NORTH OF  
GORDO, PICKENS COUNTY, IN 1901.

*Gray, sandy upland with yellow clay subsoil.*

The original growth is reported as shortleaf pine and sweet gum, which had been removed about twenty years before. On this soil cotton sometimes rusts, but there was no rust on plots fertilized with kainit in 1901. The season was dry.

*Gordo, Tuscaloosa, and Hamilton experiments.*

Plot No.	FERTILIZER.		GORDO 1901		GORDO 1902		TUSCA- LOOSA 1901		HAMIL- TON 1903	
	Amount per acre	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
1	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
2	200	Cotton seed meal . . . . .	512	144	656	120	552	104	745	155
3	240	Acid phosphate . . . . .	448	80	680	144	592	144	780	190
4	00	No fertilizer . . . . .	368		536		448		590	
5	200	Kainit . . . . .	432	87	536	00	416	-39	600	10
6	200	Cotton seed meal . . . . .	568	458	808	272	812	351	870	280
7	240	Acid phosphate . . . . .								
8	200	Cotton seed meal . . . . .	592	272	640	104	702	532	840	250
9	200	Kainit . . . . .								
10	240	Acid phosphate . . . . .	536	91	800	64	696	223	810	220
	200	No fertilizer . . . . .	256		536		480			
	200	Cotton seed meal . . . . .								
	240	Acid phosphate . . . . .	616	360	896	360	960	480	980	390
	200	Kainit . . . . .								
	200	Cotton seed meal . . . . .								
	240	Acid phosphate . . . . .	608	352	848	312	792	231	870	280
	100	Kainit . . . . .								

A complete fertilizer gave the best yield. In a complete fertilizer 100 pounds of kainit was sufficient, plot 10 affording a net profit of \$4.52.

Increase of seed cotton per acre when cotton seed meal added:

To unfertilized plot .....	144 lbs.
To acid phosphate plot .....	165 lbs.
To kainit plot .....	185 lbs.
To acid phosphate and kainit plot .....	69 lbs.

---

Average increase with cotton seed meal.....181 lbs.

Increase of seed cotton per acre when acid phosphate was ad

To unfertilized plot .....	80 lbs.
To cotton seed meal plot .....	101 lbs.
To kainit plot .....	204 lbs.
To cotton seed meal and kainit plot .....	88 lbs.

---

Average increase with acid phosphate .....118 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	87 lbs.
To cotton seed meal plot .....	121 lbs.
To acid phosphate plot .....	211 lbs.
To cotton seed meal and acid phosphate plot ..	115 lbs.

---

Average increase with kainit .....133 lbs.

---

EXPERIMENT MADE BY D. W. DAVIS, 11½ MILES NORTHEAST  
GORDO, PICKENS COUNTY, IN 1902.

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*Snuff colored, sandy clay loam with dark reddish  
subsoil.*

---

This upland field had been in cultivation for many years, the two preceding crops being corn with a scant growth of cowpeas between the rows. The original growth was oak, black jack oak, hickory and pine. The stand was poor. For yield and increase see table on page 39.

A complete fertilizer gave the largest yield and a profit on plot 9 of \$3.96 per acre. While all three fertilizers were beneficial, the chief need was for phosphate. Preceding crops of cowpeas obscured the results from cotton.

meal. Kainit, though useful, was less needed than it was the preceding year on the apparently lighter soil of Mr. French's farm.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	120 lbs.
To acid phosphate plot .....	128 lbs.
To kainit plot .....	104 lbs.
To acid phosphate and kainit plot .....	96 lbs.

---

Average increase with cotton seed meal ..... 112 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	144 lbs.
To cotton seed meal plot .....	152 lbs.
To kainit plot .....	264 lbs.
To cotton seed meal and kainit plot .....	256 lbs.

---

Average increase with acid phosphate ..... 204 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	00 lbs.
To cotton seed meal plot .....	—16 lbs.
To acid phosphate plot .....	120 lbs.
To cotton seed meal and acid phosphate plot..	88 lbs.

---

Average increase with kainit ..... 64 lbs.

---

EXPERIMENT CONDUCTED BY E. J. DAFFIN, 3½ MILES SOUTH  
OF TUSCALOOSA, IN 1901.

---

*Gray, sandy soil, with yellow subsoil.*

This field had been cleared about sixty years. The original growth is reported as oak, hickory, shortleaf pine, sweet gum, elm, mulberry, poplar and beech.

Black rust was severe on all plots. The season was dry until August, when excessive rains occurred.. The stands were very thin, but uniform on each plot.

The largest yield was made with the complete fertilizer. Six hundred and forty pounds of a complete fertilizer on

plot 9 increased the yield 480 pounds of seed cotton per acre (at 8 cents for lint) a net profit of \$7.10 per acre by paying for fertilizers and cost of ginning and picking. The increase. Cotton seed meal was important, and phosphate was equally so; kainit was useful, but less needed than the other two, and was effective only when combined with both of the others.

The results of the 1901 test are in accord with experiments made by Mr. Daffin in 1900 on the same land (property of Hon. F. S. Moody) and with those obtained by him in 1897 and 1898 on the county Poor-house farm.

**Increase of seed cotton per acre when cotton seed meal was added:**

To unfertilized plot .....	104 lb
To acid phosphate plot .....	207 lb
To kainit plot .....	292 lb
To acid phosphate and kainit plot .....	257 lb

**Average increase with cotton seed meal..... 215 lb**

**Increase of seed cotton per acre when acid phosphate was added:**

To unfertilized plot .....	144 lb
To cotton seed meal plot .....	247 lb
To kainit plot .....	262 lb
To cotton seed meal and kainit plot .....	227 lb

**Average increase with acid phosphate ..... 220 lb**

**Increase of seed cotton per acre when kainit was added:**

To unfertilized plot .....	39 lb
To cotton seed meal plot .....	149 lb
To acid phosphate plot .....	79 lb
To cotton seed meal and acid phosphate plot .....	129 lb

**Average increase with kainit ..... 79 lb**

We may safely conclude that on soils of this class near Tuscaloosa cotton requires a large proportion of phosphate, considerable cotton seed meal, and less of kainit than of either meal or phosphate.

For yields and increase see table on page 39.

EXPERIMENT CONDUCTED BY THE SIXTH DISTRICT AGRICULTURAL SCHOOL AT HAMILTON, MARION COUNTY, IN 1903.

*Soil dark loam with light red subsoil.*

This upland soil had been cleared many years, then thrown out of cultivation, and again taken into cultivation five years before the test began.

On plots 7, 9 and 10 the stand was imperfect. The largest yield was made with the complete fertilizer, but potash was less needful than either cotton seed meal or phosphate.

The largest net profit, on plot 9, was \$3.46.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	155 lbs.
To acid phosphate plot .....	90 lbs.
To kainit plot .....	240 lbs.
To acid phosphate and kainit plot .....	170 lbs.

Average increase with cotton seed meal ..... 163 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	190 lbs.
To cotton seed meal plot .....	125 lbs.
To kainit plot .....	210 lbs.
To cotton seed meal and kainit plot .....	140 lbs.

Average increase with acid phosphate ..... 166 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	10 lbs.
To cotton seed meal plot .....	95 lbs.
To acid phosphate plot .....	30 lbs.
To cotton seed meal and acid phosphate plot .....	110 lbs.

Average increase with kainit ..... 61 lbs.



EXPERIMENT MADE BY FIFTH DISTRICT AGRICULTURAL  
SCHOOL, WETUMPKA, IN 1901.

*Dark gray loam soil with reddish subsoil.*

This upland field is reported as having been cleared about twenty years before of its growth of longleaf pines and small water oaks.

For the three years preceding the experiment it was uncultivated and grew up in grass and briers.

There was little or no black rust. The stand was uniform.

The average results indicate that the chief need was for phosphate. Neither kainit nor cotton seed meal was of much use the first year after the plowing in of large amounts of vegetable matter. The need for phosphate is also suggested by the results of the 1903 inconclusive experiment on the same farm. See pages 47 and 71.

The largest net profit was from plot 5, \$4.65.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	64 lbs.
To acid phosphate plot .....	116 lbs.
To kainit plot .....	63 lbs.
To acid phosphate and kainit plot .....	—93 lbs.

Average increase with cotton seed meal ..... 37 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	170 lbs.
To cotton seed meal plot .....	222 lbs.
To kainit plot .....	234 lbs.
To cotton seed meal and kainit plot .....	78 lbs.

Average increase with acid phosphate ..... 176 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	67 lbs.
To cotton seed meal plot .....	66 lbs.
To acid phosphate plot .....	131 lbs.
To cotton seed meal and acid phosphate plot .....	78 lbs.

---

Average increase with kainit ..... 46 lbs.

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EXPERIMENT MADE BY J. D. BILLINGSLEY, FIVE MILES WEST  
OF TALLASSEE, IN ELMORE COUNTY, IN 1903.

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*Black sandy upland; light colored subsoil.*

The original growth of longleaf pine and oak had been removed about thirty years before. There was no rust and very little shedding. All plots were thinned to the same number of plants, namely, 5,760 per acre.

The rainfall was favorable. For yields see page 47.

The largest yield was obtained from the complete fertilizer which afforded an increase of 552 pounds of seed cotton per acre, or a net profit on plot 6 of \$8.97, and on plot 10 of \$9.67. The principal need was for potash and nitrogen, this being one of the few soils where, in the absence of rust, kainit was more important than acid phosphate.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	136 lbs.
To acid phosphate plot .....	204 lbs.
To kainit plot .....	470 lbs.
To acid phosphate and kainit plot .....	225 lbs.

---

Average increase with cotton seed meal ..... 258 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	40 lbs.
To cotton seed meal plot .....	108 lbs.
To kainit plot .....	301 lbs.
To cotton seed meal and kainit plot .....	56 lbs.

---

Average increase with acid phosphate ..... 126 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	26 lbs.
To cotton seed meal plot .....	360 lbs.
To acid phosphate plot .....	287 lbs.
To cotton seed meal and acid phosphate plot ..	308 lbs.

---

Average increase with kainit .....245 lbs.

---

EXPERIMENT MADE BY J. P. SLATON, SEVEN MILES SOUTH OF  
NOTASULGA.

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*This test was made on gray sandy hillside with stiffer red-  
dish subsoil.*

---

The original growth was longleaf pine, oak, hickory and gum, cleared eight years before. For two years preceding the experiment the land was pastured. Unfortunately the land was not plowed until May 17th, which delay reduced the yields. The stand was good on all plots. For yields and increase see table on page 47.

The complete fertilizer was most profitable, plot 9 giving an increase of 544 pounds of seed cotton per acre, equivalent to a net profit of \$8.76 per acre.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	256 lbs.
To acid phosphate plot .....	105 lbs.
To kainit plot .....	173 lbs.
To acid phosphate and kainit plot .....	210 lbs.

---

Average increase with cotton seed meal .....186 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	276 lbs.
To cotton seed meal plot .....	129 lbs.
To kainit plot .....	128 lbs.
To cotton seed meal and kainit plot .....	165 lbs.

---

Average increase with acid phosphate .....174 lbs

crease of seed cotton per acre when kainit was added:

To unfertilized plot .....	206 lbs
To cotton seed meal plot .....	123 lbs.
To acid phosphate plot .....	58 lbs.
To cotton seed meal and acid phosphate plot .....	162 lbs.

Average increase with kainit ..... 137 lbs.

*umpka, Tallassee, Notasulga and Auburn fertilizer experiments.*

FERTILIZER.		WE-TUMPKA 1901		TAL-LASSEE 1903		NOTA-SULGA 1904		AUBURN 1902	
Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
bs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
200	Cotton seed meal .....	424	64	480	136	528	256	594	178
240	Acid phosphate .....	536	170	384	40	548	276	477	63
00	No fertilizer .....	360		344		272		416	
200	Kainit .....	432	67	376	26	472	206	629	201
200	Cotton seed meal .....	656	286	600	244	640	381	580	140
240	Acid phosphate .....								
200	Cotton seed meal .....								
200	Kainit .....	504	130	832	469	632	379	662	211
240	Acid phosphate .....	680	301	696	327	580	334	648	185
200	Kainit .....								
00	No fertilizer .....								
200	Cotton seed meal .....	384		376		240		475	
240	Acid phosphate .....	592	208	928	552	784	544	741	266
200	Kainit .....								
200	Cotton seed meal .....								
240	Acid phosphate .....	664	280	926	550	564	324	729	254
100	Kainit .....								

EXPERIMENT ON STATION FARM AT AUBURN, IN 1902.

*Light, sandy soil with porous sandy subsoil.*

This test was made on the poorest hilltop on the station

farm where no leguminous crop had grown for a number of years. The absence of any considerable rain between April and August ruined the yield.

The stand was uniform on all plots. The chief need of this sand bank this excessively dry year was for kainit, the largest yield was from complete fertilizer.

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EXPERIMENT CONDUCTED BY W. T. CHISM, IN 1901, 1902  
1903, AT VICK, BIBB COUNTY.

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*Grayish, sandy, second bottom with yellow subsoil*

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This land has been long in cultivation. On adjacent similar land the forest growth consists of shortleaf pine, white and red oaks, gum, cucumber tree, dogwood, hickory and beech. For yields and increase see table on page 49.

*In 1901.* All plots were reduced to the same number of plants, 6,400 per acre. The two preceding crops had been cotton. The largest increase, 388 pounds of seed cotton per acre, or a net profit of \$5.31 per acre, was obtained where a complete fertilizer was used. This year nitrogen was apparently the plant food chiefly needed, but both phosphoric acid and potash were advantageous. There was practically no rust on any plot.

*In 1902.* Dry weather, almost continuous from April to August, made the yields on all plots low and all fertilizers practically useless.

*In 1903.* The two preceding crops had been cotton. The spring was late and cold. No rust occurred. As in 1902, cotton seed meal greatly increased the yield while phosphate and kainit were less important, but advantageous. Plot 10 afforded the largest increase, 446 pounds, or a net profit of \$6.19 per acre.

The results suggest that the phosphate in the complete fertilizer might have been much reduced without injuring the crop.

Mr. Chism also made similar experiments in 1899 and 1900. In those years cotton seed meal was the only fertilizer that was of material advantage. The results as a whole indicate that on this second bottom a fertilizer of unusual composition is required and that it should contain more of cotton seed meal than of any other fertilizer.

*Experiments at Vick, Bibb county.*

Plot No.	FERTILIZER.		VICK 1901		VICK 1902		VICK 1903	
	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots	Yield of seed cotton per acre.	Increase over unfertilized plots	Yield of seed cotton per acre.	Increase over unfertilized plots
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal .....	676	122	352	48	864	242
2	240	Acid phosphate .....	612	128	360	56	572	-50
3	00	No fertilizer .....	484		304		622	
4	200	Kainit .....	636	156	364	57	700	75
5	200	Cotton seed meal ...	732	256	412	102	970	248
	240	Acid phosphate .....						
6	200	Cotton seed meal ...	740	268	400	86	940	310
	200	Kainit .....						
7	240	Acid phosphate .....	716	248	432	115	752	119
	200	Kainit .....						
8	00	No fertilizer .....	464		320		636	
	200	Cotton seed meal ...						
9	240	Acid phosphate .....	852	388	432	112	1024	388
	200	Kainit .....						
10	200	Cotton seed meal ...	728	264	428	108	1052	416
	240	Acid phosphate .....						
	100	Kainit .....						

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1903
To unfertilized plot .....	192 lbs.	242 lbs.
To acid phosphate plot .....	128 lbs.	398 lbs.
To kainit plot .....	112 lbs.	235 lbs.
To acid phosphate and kainit plot .....	140 lbs.	262 lbs.

Average increase with cotton seed meal.....143 lbs. 284 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	128 lbs.	50 lbs.
To cotton seed meal plot .....	64 lbs.	106 lbs.
To kainit plot .....	92 lbs.	44 lbs.
To cotton seed meal and kainit plot .....	120 lbs.	84 lbs.

---

Average increase with acid phosphate .....

101 lbs. 46 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	156 lbs.	75 lbs.
To cotton seed meal plot .....	76 lbs.	68 lbs.
To acid phosphate plot .....	120 lbs.	189 lbs.
To cotton seed meal and acid phosphate plot .....	132 lbs.	40 lbs.

---

Average increase with kainit .....

121 lbs. 88 lbs.

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EXPERIMENT MADE BY THE SOUTHERN INDUSTRIAL INSTITUTE,  
CAMP HILL, TALLAPOOSA COUNTY, IN 1902.

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*Gray, sandy soil, with sandy subsoil.*

A protracted drought made all fertilizers practically useless, the average increase from cotton seed meal being only 18 pounds, from phosphate 31 pounds, and from kainit 17 pounds. The most favorable result, on plot 7, entailed a loss on account of fertilizers of 94 cents per acre.

---

EXPERIMENTS MADE 2½ MILES SOUTH OF HANOVER, COOSA  
COUNTY, BY J. M. LOGAN, IN 1902.

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*Dark gray sandy soil with some rock; yellowish subsoil.*

The original growth, removed about 40 years before, consisted of longleaf pine, hickory and oak. Recent crops have all been cotton. The largest increase, 392 pounds of seed cotton per acre, was obtained from the use of a complete fertilizer, affording a net profit of \$5.56 per acre. Phosphate used alone or with kainit, was of little value, but combined with both it was highly advantageous.

*Camp Hill, Hanover, Florence and Athens experiments.*

Plot No.	FERTILIZER.		CAMP HILL 1902		HAN-OVER 1903		FLORENCE 1904		ATHENS 1904	
	Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
1	200	Cotton seed meal .....	Lbs. 576	Lbs. 32	Lbs. 360	Lbs. 120	Lbs. 732	Lbs. 284	Lbs. 560	Lbs. 208
2	240	Acid phosphate .....	536	—8	264	24	1144	696	600	248
3	00	No fertilizer .....	544		240		448		352	
4	200	Kainit .....	528	—15	376	137	784	334	656	295
5	200	Cotton seed meal .....	584	43	352	116	1416	965	728	357
6	240	Acid phosphate .....	656	27	368	132	1024	571	760	379
7	200	Kainit .....	624	86	384	151	1272	828	592	201
8	00	No fertilizer .....	536		232		456		400	
9	200	Cotton seed meal .....	576	40	536	304	1492	1036	816	416
10	240	Acid phosphate .....	536	00	624	392	1200	744	872	472
	100	Kainit .....								

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot ..... 120 lbs.  
 To acid phosphate plot ..... 92 lbs.  
 To kainit plot ..... 4 lbs.  
 To acid phosphate and kainit plot ..... 153 lbs.

Average increase with cotton seed meal ..... 90 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..... 24 lbs.  
 To cotton seed meal plot ..... —4 lbs.  
 To kainit plot ..... 11 lbs.  
 To cotton seed meal and kainit plot ..... 171 lbs.

Average increase with acid phosphate ..... 50 lbs.



Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	136 lbs.
To cotton seed meal plot .....	13 lbs.
To acid phosphate plot .....	127 lbs.
To cotton seed meal and acid phosphate plot .....	188 lbs.

---

Average increase with kainit .....113 lbs.

---

EXPERIMENT MADE BY W. A. PARISH, TEN MILES WEST OF  
FLORENCE, LAUDERDALE COUNTY.

---

*Light, gray soil with pale reddish subsoil.*

---

This field had been cleared 40 or 50 years. The original growth is reported as post oak and black jack oak.

The experimenter reports that there was no black rust, but that "red rust" was present, but did little damage. The season was dry. The stand was good and uniform.

The complete fertilizer more than trebled the yield of the unfertilized plots, raising the yield to about a bale per acre. This is an increase of 1,036 pounds of seed cotton, equal to a net profit of \$21.56 per acre after paying for fertilizer and picking and ginning of increase. Every fertilizer, whether applied singly, by twos, or all three together, profitably increased the yield. The fertilizer most needed was phosphate. The one least needed was kainit which, however, was profitable.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	284 lbs.
To acid phosphate plot .....	269 lbs.
To kainit plot .....	237 lbs.
To acid phosphate and kainit plot .....	208 lbs.

---

Average increase with cotton seed meal .....249 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	696 lbs.
To cotton seed meal plot .....	681 lbs.
To kainit plot .....	494 lbs.
To cotton seed meal and kainit plot .....	465 lbs.

---

Average increase with acid phosphate .....584 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	334 lbs.
To cotton seed meal plot .....	287 lbs.
To acid phosphate plot .....	132 lbs.
To cotton seed meal and acid phosphate plot..	71 lbs.

---

Average increase with kainit .....212 lbs.

---

EXPERIMENT MADE BY P. G. WILLIAMS, 11½ MILES WEST OF  
ATHENS, LIMESTONE COUNTY.

---

*Dark brown loam or clay with red subsoil.*

This field had been cleared many years. The original growth is reported as oak, black jack oak, gum and popuar.

There was no rust, but drought and early frost cut short the yield. The most profitable fertilizer was the complete one containing 100 pounds of kainit. With this the increase was 472 pounds of seed cotton per acre, thus affording a net profit above the cost of fertilizer and picking and ginning of increase of \$7.64 per acre. However, all fertilizers whether applied singly, by twos, or by threes, profitably increased the yield.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	208 lbs.
To acid phosphate plot .....	109 lbs.
To kainit plot .....	84 lbs.
To acid phosphate and kainit plot .....	215 lbs.

---

Average increase with cotton seed meal .....154 lbs.

**Increase of seed cotton per acre when acid phosphate was added:**

To unfertilized plot .....	284 lbs.
To cotton seed meal plot .....	149 lbs.
To kainit plot .....	—94 lbs.
To cotton seed meal and kainit plot .....	37 lbs.

---

**Average increase with acid phosphate ..... 85 lbs.**

**Increase of seed cotton per acre when kainit was added:**

To unfertilized plot .....	295 lbs.
To cotton seed meal plot .....	171 lbs.
To acid phosphate plot .....	—47 lbs.
To cotton seed meal and acid phosphate plot..	59 lbs.

---

**Average increase with kainit ..... 119 lbs.**

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**EXPERIMENTS BY W. G. BEVILL, NAHEOLA, CHOCTAW COUNTY,  
IN 1901 AND 1902.**

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*"Mulatto" upland with clay subsoil.*

The land had been long in cultivation. The original growth was reported as both long and shortleaf pine. The immediately preceding crops were cotton.

For yields see table on page —

Rust was worst on plot 5, but there was little of it on the kainit plots. Dry weather from June to August, followed by a violent storm, greatly reduced the yield. The stand was good.

In 1901. The largest increase, 448 pounds of seed cotton per acre, was from a complete fertilizer. However, in a complete fertilizer, 100 pounds of kainit was sufficient; plot 9 afforded a net profit of \$8.13 per acre.

In 1902. In spite of the drought from April till August, cotton seed meal and acid phosphate profitably increased the yield. Plot 5 afforded an increase of 247 pounds, or a net profit of \$2.54, or a few cents less than plot 10 and a few cents less than plot 9.

*Nahcola, Greenville, and Evergreen experiments.*

FERTILIZER.		NA- HEOLA 1901		NA- HEOLA 1902		GR'EN- VILLE 1901		EVER- GREEN 1902	
Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
<i>Lbs</i>		<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>	<i>Lbs</i>
200	Cotton seed meal .....	648	120	400	-32	632	304	384	80
240	Acid phosphate .....	664	136	504	72	616	288	384	80
00	No fertilizer .....	528		432		228		304	
200	Kainit .....	664	130	296	-141	352	24	224	-64
200	Cotton seed meal ...	760	220	688	247	696	268	672	400
240	Acid phosphate .....								
200	Cotton seed meal ...	856	310	616	170	664	326	696	440
200	Kainit .....								
240	Acid phosphate .....	696	143	600	149	528	200	688	448
200	Kainit .....								
00	No fertilizer .....	560		456				224	
200	Cotton seed meal ...	1008	448	744	288	632	304	800	592
240	Acid phosphate .....								
200	Kainit .....	1000	440	744	288	784	456	768	576
240	Acid phosphate .....								
100	Kainit .....								

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1902
to unfertilized plot .....	120 lbs.	-32 lbs.
to acid phosphate plot .....	84 lbs.	175 lbs.
to kainit plot .....	180 lbs.	311 lbs.
to acid phosphate and kainit plot .....	305 lbs.	139 lbs.

Average increase with cotton seed meal.....172 lbs. 145 lbs.

Increase of seed cotton per acre when acid phosphate was added:

to unfertilized plot .....	136 lbs.	72 lbs.
to cotton seed meal plot .....	100 lbs.	279 lbs.
to kainit plot .....	13 lbs.	290 lbs.
to cotton seed meal and kainit plot .....	138 lbs.	118 lbs.

Average increase with acid phosphate ..... 96 lbs. 189 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	130 lbs.—141 lbs.
To cotton seed meal plot .....	190 lbs. 202 lbs.
To acid phosphate plot .....	7 lbs. 75 lbs.
To cotton seed meal and acid phosphate plot....	228 lbs. 41 lbs.
<hr/>	
Average increase with kainit .....	138 lbs. 44 lbs.

EXPERIMENT BY D. H. ROUSE, GREENVILLE, IN 1901.

*Worn, red land.*

The average increase is the greatest with cotton seed meal, 172 pounds of seed cotton per acre, and next with acid phosphate. Kainit was ineffective. This test is not entirely conclusive.

For table of yields see page 55.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	304 lbs.
To acid phosphate plot .....	—20 lbs.
To kainit plot .....	302 lbs.
To acid phosphate and kainit plot .....	104 lbs.

Average increase with cotton seed meal.....172 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	288 lbs.
To cotton seed meal plot .....	—36 lbs.
To kainit plot .....	176 lbs.
To cotton seed meal and kainit plot .....	—22 lbs.

Average increase with acid phosphate .....101 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	24 lbs.
To cotton seed meal plot .....	22 lbs.
To acid phosphate plot .....	—88 lbs.
To cotton seed meal and acid phosphate plot ..	36 lbs.

Average decrease with kainit ..... 1 lbs.

EXPERIMENT BY J. W. STUART, AT EVERGREEN, IN 1902.

*Gray sandy upland with reddish subsoil.*

For yields see page 55.

There was no rust. The stand was uniform. In spite of the severe drought every combination of fertilizers effected a highly profitable increase in the crop. However, when used separately, no fertilizer material exerted its full effect.

The largest increase, 592 pounds of seed cotton per acre, resulted from the use of a complete fertilizer, but in the complete fertilizer 100 pounds of kainit was nearly as effective as a larger amount. Plot 10 afforded a net profit of \$10.34 per acre after paying for fertilizer and for picking and ginning the increase.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	80 lbs
To acid phosphate plot .....	320 lbs.
To kainit plot .....	504 lbs.
To acid phosphate and kainit plot .....	144 lbs.

Average increase with cotton seed meal .....264 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	80 lbs.
To cotton seed meal plot .....	320 lbs.
To kainit plot .....	512 lbs.
To cotton seed meal and kainit plot .....	152 lbs.

Average increase with acid phosphate .....266 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	—64 lbs.
To cotton seed meal plot .....	360 lbs.
To acid phosphate plot .....	368 lbs.
To cotton seed meal and acid phosphate plot ..	192 lbs.

Average increase with kainit .....214 lbs.

EXPERIMENT CONDUCTED BY J. D. VEAL, THREE MILES N  
OF LOUISVILLE, BARBOUR COUNTY.

*Gray, sandy soil, with stiffer gray subsoil.*

This upland field had been cleared of its growth of  
and hickory and longleaf pine about thirty years b  
For the two years preceding this experiment corn  
grown on this land, but whether cowpeas were grow  
tween the corn rows was not stated.

The stand on all plots was good. A complete fer  
afforded the largest increase in yield, 474 pounds of  
cotton per acre, a net profit of \$6.94 per acre. The  
plete fertilizer with 200 pounds of kainit was a little  
profitable than the one containing 100 pounds of k  
This is a case in which the increased yield from kaini  
not due to its influence on rust, for Mr. Veal reports  
there was no rust on any plot. See table page 66.

The combination of acid phosphate and cotton seed  
was highly profitable, but less so than the complete  
izers.

Increase of seed cotton per acre when cotton seed meal was a

To unfertilized plot .....	48 lbs.
To acid phosphate plot .....	253 lbs.
To kainit plot .....	301 lbs.
To acid phosphate and kainit plot .....	242 lbs.

Average increase with cotton seed meal .....211 lbs.

Increase of seed cotton per acre when acid phosphate was a

To unfertilized plot .....	120 lbs.
To cotton seed meal plot .....	325 lbs.
To kainit plot .....	268 lbs.
To cotton seed meal and kainit plot .....	209 lbs.

Average increase with acid phosphate .....230 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	—34 lbs.
To cotton seed meal plot .....	219 lbs.
To acid phosphate plot .....	114 lbs.
To cotton seed meal and acid phosphate plot ..	103 lbs.
<hr/>	
Average increase with kainit .....	100 lbs.

EXPERIMENT MADE BY C. A. HATCHER, TWO MILES SOUTHEAST-  
OF ENTERPRISE, COFFEE COUNTY.

*Gray, sandy loam, with stiff gray subsoil.*

The longleaf pines had been cut on this field about 18 years before. There were 7,360 plants per acre on all plots. For yields and increase see table on page 60. The crop preceding the experiment was corn with cowpeas in the drill and peanuts between the corn rows. It is not stated whether the peanuts were consumed as usual by hogs on the land, or removed.

In spite of these preceding leguminous crops and of the fact that the corn had been fertilized with eight bushels of cotton seed per acre, the application of cotton seed meal to cotton was decidedly profitable. The material most needed was acid phosphate. The greatest increase in yield, 616 pounds of seed cotton worth \$16.01 net, resulted from the use of 640 pounds of a complete fertilizer, and this complete fertilizer afforded a net profit of \$10.63 per acre.

Kainit was distinctly advantageous and profitable whenever combined with acid phosphate. The complete fertilizer combining 200 pounds of kainit was more profitable than the one with 100 pounds.

No mention is made of rust.



*Louisville, Enterprise, Georgiana, and Garland experim*

Plot No.	Amount per acre.	FERTILIZER.  KIND.	LOUISVILLE 1904		ENTERPRISE 1904		GEORGIANA 1904	
			Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal .....	240	48	552	272	976	64
2	240	Acid phosphate .....	312	120	536	256	1112	200
3	00	No fertilizer .....	192		280		912	
4	200	Kainit .....	184	—34	304	24	976	70
5	200	Cotton seed meal .....	616	373	680	400	1264	364
	240	Acid phosphate .....						
6	200	Kainit .....						
	200	Cotton seed meal .....	536	267	528	248	1184	291
7	240	Acid phosphate .....						
	200	Kainit .....	528	234	768	488	1096	210
8	00	No fertilizer .....	320		280		880	
9	200	Cotton seed meal .....						
	240	Acid phosphate .....	796	476	896	616	264	384
	200	Kainit .....						
10	200	Cotton seed meal .....						
	240	Acid phosphate .....	724	404	800	520	240	360
	100	Kainit .....						

Increase of seed cotton per acre when cotton seed meal was

To unfertilized plot .....272 lb

To acid phosphate plot .....144 lb

To kainit plot .....224 lb

To acid phosphate and kainit plot .....128 lb

Average increase with cotton seed meal .....192 lb

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot .....256 lb

To cotton seed meal plot .....128 lb

To kainit plot .....464 lb

To cotton seed meal and kainit plot .....368 lb

Average increase with acid phosphate .....304 lb

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	24 lbs.
To cotton seed meal plot .....	—24 lbs.
To acid phosphate plot .....	232 lbs.
To cotton seed meal and acid phosphate plot ..	216 lbs.

---

Average increase with kainit .....112 lbs.

---

EXPERIMENTS MADE BY J. C. LEE, 1904, 1 1-4 MILES NORTH  
OF GEORGIANA.

---

*Gray "pineywoods" upland with red clay subsoil.*

---

The land had been cleared about ten years. The original growth was longleaf pine with some oak, hickory, and dogwood.

There had been no cowpeas on this land in recent years.

There was no rust, but shedding was severe. The stand was good and uniform. For yields see page 60. The most profitable increase, 364 pounds of seed cotton per acre, resulted from the use of cotton seed meal and acid phosphate. This mixture gave a net profit of \$5.58 per acre. The addition of kainit to this mixture was not notably helpful. The chief need of this soil was for phosphate and not kainit. The chief need of this soil was for phosphate and next

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot .....	64 lbs.
To acid phosphate plot .....	164 lbs.
To kainit plot .....	221 lbs.
To acid phosphate and kainit plot .....	174 lbs.

---

Average increase with cotton seed meal .....155 lbs.

Increase of seed cotton per acre when acid phosphate was

To unfertilized plot .....	200 lbs
To cotton seed meal plot .....	300 lbs
To kainit plot .....	140 lbs
To cotton seed meal and kainit plot .....	193 lbs

---

Average increase with acid phosphate ..... 208 lbs

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	70 lbs
To cotton seed meal plot .....	227 lbs
To acid phosphate plot .....	10 lbs
To cotton seed meal and acid phosphate plot ..	20 lbs

---

Average increase with kainit ..... 81 lbs

---

EXPERIMENT MADE IN 1901, BY G. L. McLURE, TWO  
EAST OF GARLAND, BUTLER COUNTY.

---

This gray upland pine soil had been cleared about 20 years. The original growth was longleaf pine and jack oak. The preceding crop was oats. Acid phosphate was highly profitable and cotton seed meal effective. Kainit was effective only when combined with the other two. The largest increase, 560 pounds of seed cotton per acre, was obtained from the use of a complete fertilizer. The yield of plot 9, gave a net profit of \$9.46 per acre. For yield table on page 60.

Two experiments previously made by Mr. McLure and two made near by at Lumber Mills, accord with the results here recorded in showing that the pinewoods soils of this region are highly responsive to a mixture of acid phosphate and cotton seed meal, and that kainit is highly beneficial only when rust is severe.

**Increase of seed cotton per acre when cotton seed meal was added:**

To unfertilized plot .....	296 lbs.
To acid phosphate plot .....	—2 lbs.
To kainit plot .....	86 lbs.
To acid phosphate and kainit plot .....	123 lbs.

---

**Average increase with cotton seed meal .....** 125 lbs.

**Increase of seed cotton per acre when acid phosphate was added:**

To unfertilized plot .....	448 lbs.
To cotton seed meal plot .....	150 lbs.
To kainit plot .....	386 lbs.
To cotton seed meal and kainit plot .....	423 lbs.

---

**Average increase with acid phosphate .....** 351 lbs.

**Increase of seed cotton per acre when kainit was added:**

To unfertilized plot .....	51 lbs.
To cotton seed meal plot .....	—159 lbs.
To acid phosphate plot .....	—11 lbs.
To cotton seed meal and acid phosphate plot .....	114 lbs.

---

**Average decrease with kainit .....** 1 lbs.

---

**EXPERIMENT MADE BY W. H. SIMMONS, MIDLAND CITY,  
DALE COUNTY.**

---

Alone none of the fertilizers was very advantageous, but as a complete fertilizer all three were decidedly beneficial. The largest increase, 296 pounds of seed cotton per acre, resulted from the use of the complete fertilizer on plot 9. This afforded a net profit of \$2.32 per acre, which is nearly nine cents more than the profit on plot 10, where less kainit was used. See table on page 64.

**Increase of seed cotton per acre when cotton seed meal was added:**

To unfertilized plot .....	88 lbs.
To acid phosphate plot .....	127 lbs.
To kainit plot .....	86 lbs.
To acid phosphate and kainit plot .....	139 lbs.

---

**Average increase with cotton seed meal .....** 110 lbs.

Increase of seed cotton per acre when acid phosphate was added

To unfertilized plot .....	56 lbs.
To cotton seed meal plot .....	95 lbs.
To kainit plot .....	113 lbs.
To cotton seed meal and kainit plot .....	166 lbs.

Average increase with acid phosphate ..... 107 lbs.

Increase of seed cotton per acre when kainit was added

To unfertilized plot .....	44 lbs.
To cotton seed meal plot .....	42 lbs.
To acid phosphate plot .....	101 lbs.
To cotton seed meal and acid phosphate plot ..	113 lbs.

Average increase with kainit ..... 75 lbs.

*Midland City and Geneva experiments.*

Plot No.	Amount per acre.	FERTILIZER.	KIND.	MID- LAND CITY 1904		GE- NEVA 1901		GE- NEVA 1902	
				Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
	Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal .....		312	88	488	112	763	8
2	240	Acid phosphate .....		280	56	672	295	880	120
3	00	No fertilizer .....		224		376		768	
4	200	Kainit .....		264	44	424	48	1088	359
5	200	Cotton seed meal .....							
	240	Acid phosphate .....		400	183	600	224	1000	323
6	200	Cotton seed meal .....							
	240	Acid phosphate .....		344	130	448	72	1008	373
7	200	Kainit .....							
	240	Acid phosphate .....		368	157	608	232	1016	423
8	00	No fertilizer .....		208		376		552	
9	200	Cotton seed meal .....							
	240	Acid phosphate .....		504	296	640	264	1040	488
	200	Kainit .....							
10	200	Cotton seed meal .....							
	240	Acid phosphate .....		472	264	600	224	912	360
	100	Kainit .....							

EXPERIMENTS BY P. M. METCALF, 4½ MILES NORTH OF  
GENEVA.

---

*Gray or light sandy upland with stiffer red subsoil, eight  
inches from surface.*

---

For yields see table on pages 64 and 74.

*In 1901.* This was the fourth crop after clearing, all previous crops being corn with cowpeas and peanuts between. No mention is made of rust.

On this fresh land where leguminous crops had grown for several years, phosphate was the only material of marked value. Phosphate alone increased the yield 296 pounds of seed cotton per acre, affording a net profit of \$6.02 per acre, after paying cost of fertilizer and picking and ginning of increase.

*In 1902.* The immediately preceding crop was oats, which in turn had been preceded by two crops of corn, probably with cowpeas or peanuts between, as is customary in that locality.

The time since clearing is not stated.

Protracted drought and abundance of cotton caterpillars in October reduced the yields. No mention is made of black rust, but Mr. Metcalf writes that "Plots 1, 2, 3, 4 and 8 had much of what we know as red rust." In this unfavorable year kainit was by far the most effective single fertilizer, increasing the yield when used alone 369 pounds. The complete fertilizer containing a full ration of kainit increased the yield 488 pounds of seed cotton, affording a net profit of \$6.31 per acre.

Mr. Metcalf writes: "I learn from this experiment that it pays to use lots of guano and of high quality."

*In 1903.* This was the sixth year since the clearing of this land. The crops in 1902 were oats, followed by Spanish peanuts. There was no rust. This experiment is rendered inconclusive by the wide variation in the yields of

the two unfertilized plots and by the contradictory results on plots 9 and 10, hence it is recorded in the table on page 74.

*In 1904.* Cotton in this experiment constituted the fourth crop since clearing. The two preceding crops had been corn and peanuts, the peanuts not picked. The summer was dry. The largest increase, 528 pounds of seed cotton per acre, was made by the complete fertilizer, affording a net profit above cost of fertilizer, ginning and picking of \$9.38 per acre.

Again the chief need seems to have been for kainit, acid phosphate being almost as important, and cotton seed meal somewhat less important by reason of recent crops of peanuts.

Increase of seed cotton per acre when cotton seed meal was added:

	1901	1902	1904
To unfertilized plot .....	112 lbs.	8 lbs.	— 8 lbs.
To acid phosphate plot .....	—72 lbs.	203 lbs.	77 lbs.
To kainit plot .....	24 lbs.	4 lbs.	182 lbs.
To acid phosphate and kainit plot .....	32 lbs.	65 lbs.	286 lbs.

Average increase with cotton seed meal 24 lbs. 70 lbs. 136 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	296 lbs.	120 lbs.	48 lbs.
To cotton seed meal plot .....	112 lbs.	315 lbs.	133 lbs.
To kainit plot .....	184 lbs.	54 lbs.	76 lbs.
To cotton seed meal and kainit plot .....	192 lbs.	25 lbs.	180 lbs.

Average increase with acid phosphate 196 lbs. 128 lbs. 109 lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	48 lbs.	369 lbs.	166 lbs.
To cotton seed meal plot .....	—40 lbs.	365 lbs.	356 lbs.
To acid phosphate plot .....	—64 lbs.	303 lbs.	194 lbs.
To cotton seed meal and acid phos. plot .....	40 lbs.	165 lbs.	402 lbs.

Average increase with kainit .....—4 lbs. 300 lbs. 270 lbs.

## DO FERTILIZERS PAY?

Let the figures answer. The following table gives the average of all the 41 conclusive experiments recorded in this bulletin. It shows the average increase in seed cotton, due to fertilizers, throughout Alabama and the net profit due to fertilizers, after paying liberal prices for fertilizers, and after paying 50 cents per hundred pounds of seed cotton for picking and ginning the increased yields.

*Average increase in 41 experiments in seed cotton per acre and net profit per acre from fertilizers, after deducting cost of fertilizer and cost of picking and ginning the increase.*

Plot No.	FERTILIZER.		Increase in seed cotton from fertilizers.	Net profit per acre from fertilizers with seed at 60c per 100 lbs. and		
	Amount per acre.	KIND.		Lint at 6c.	Lint at 8c.	Lint at 10c.
	<i>Lbs.</i>		<i>Lbs.</i>	\$	\$	\$
2	240	Acid phosphate .....	55	1.26	2.35	3.36
5	200	Cotton seed meal ...	302	1.85	3.97	5.87
	240	Acid phosphate .....				
9	200	Cotton seed meal ...	91	2.04	4.78	7.25
	240	Acid phosphate .....				
	200	Kainit .....				
10	200	Cotton seed meal ...	365	2.30	4.86	7.26
	240	Acid phosphate .....				
	100	Kainit .....				

The above table deserves careful study. Even with cotton calculated at six cents per pound, fertilizers were profitable, the average net profit per acre ranging from \$1.26 to \$2.30.

With eight-cent cotton the average net profits from fertilizers assume important proportions, ranging from \$2.35 and \$4.86 per acre.



With ten cent cotton the average profits range between \$3.36 and \$7.26 per acre.

Whether cotton be priced at six, eight, or ten cents per pound, the average profit per acre was greater with a mixture of cotton seed meal and phosphate than with phosphate alone, and still greater when 100 pounds of kainit was added to this mixture, thus making a complete fertilizer.

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#### CONCLUSIONS AND SUGGESTIONS.

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*These are based on these experiments and on results published in former bulletins of this station.*

---

1. In all soil belts, except perhaps on certain grades of rich prairie soil, where tests have been made with cotton under the direction of this station acid phosphate has been almost universally beneficial.

2. Kainit is less frequently needed than either acid phosphate or cotton seed meal, and a considerable proportion of the soils on which it has been most advantageous lie in the southern part of the State. On soils where cotton is especially liable to "black rust" and in all parts of the State in seasons when that disease is especially injurious, kainit is at its best. On most soils, containing much clay, it can be profitably dispensed with. Where needed, an application of 100 pounds per acre is usually sufficient for cotton.

3. Cotton seed meal is highly beneficial to cotton on a large proportion of the cultivated area of every soil belt in Alabama. Apparently it is universally needed on uplands except on (1) new grounds and (2) on soils containing considerable vegetable matter.

4. On old soils, as a rule, it is more profitable to employ for cotton a mixture of acid phosphate and cotton seed meal or of these two and kainit, than to use an equal money value of any one of them alone.

5. The usual basis for a fertilizer formula for cotton

in regions where commercial fertilizers are generally employed should be acid phosphate, of which 100 to 240 pounds should be used per acre, in addition to cotton seed meal or other nitrogenous fertilizer as necessary.

6. The proper proportion of cotton seed meal to acid phosphate in a fertilizer formula for cotton depends largely on the recent cropping and manuring of the field.

(a) Small stalks, (if not due to climatic influences, poor cultivation, etc.) are usually an indication that nitrogen (as in cotton seed meal), is needed.

(b) Excessive stalk or "weed growth" of cotton is an indication that nitrogen can be dispensed with wholly or partially.

(c) Phosphate hastens maturity.

(d) The fresher the land the less the need for nitrogen.

(e) A luxuriant growth of cowpeas just preceding cotton dispenses with the necessity for cotton seed meal, as does a recent heavy dressing with stable manure or cotton seed.

7. Nitrogen costs about three times as much as phosphoric acid or potash and hence most of it should be produced on the farm by growing soil-improving plants, (as cowpeas, velvet beans, vetch, crimson clover, etc.) and by increasing the number of livestock and the amount of stable manure saved.

8. In response to requests for recommendations of definite fertilizer formulas for cotton on different soils, the writer would tentatively suggest the following to be modified somewhat when the facts mentioned in paragraph 6 seem to require it:

(a) For red lime lands in North Alabama; for the red clay lands occupying a triangular area in the central portion of East Alabama—for the most part north of the Western Railway and east of the Coosa River—and for the stiffer non-calcareous soils of the northwestern and western part of the State:

80 to 120 lbs. cotton seed meal per acre.

160 to 240 lbs. acid phosphate per acre.

---

240 to 360 lbs. total per acre.

(b) For sandy soils in the eastern and central the State:

80 to 120 lbs. cotton seed meal per acre.

160 to 240 lbs. acid phosphate per acre.

40 to 60 lbs. kainit per acre.

---

280 to 420 lbs. total per acre.

(c) For the level lands of the southern Long Region:

60 to 120 lbs. cotton seed meal per acre.

120 to 240 lbs. acid phosphate per acre.

60 to 80 lbs. kainit per acre.

---

240 to 440 lbs. total per acre.

(d) For any well drained soil in any part of t on which cotton is known to be especially liable rust:

120 to 160 lbs. cotton seed meal per acre.

80 to 120 lbs. acid phosphate per acre.

80 to 120 lbs. kainit per acre.

---

280 to 400 lbs. total per acre.

9. The formulas suggested above contain approx the following percentages of nitrogen (and its large lent in ammonia), available phosphoric acid, and using phosphate containing 12 1-2 per cent. of availa phoric acid. A phosphate of higher grade is advisal

FORMULA.	Per Cent. Nitrogen.....	Per Cent. Ammonia.....	Per Cent. Available Phos- phoric Acid.....	Per Cent. Potash.....
(a) For certain red lands .....	2.3	2.8	9.3	0.6
(b) For certain sandy lands .....	2.0	2.4	8.0	2.3
(c) For low longleaf pine lands ....	1.9	2.3	7.6	2.8
(d) For "rusting" soils .....	3.0	3.6	4.8	4.3

10. On the lime soils of the Central Prairie Region commercial fertilizers are not generally used. Prairie soils are often in poor mechanical condition and need vegetable matter and drainage more than commercial fertilizers. The poorer soils often need both cotton seed meal and phosphate.

#### INCONCLUSIVE EXPERIMENTS.

These sometimes afford suggestions or hints which may serve to strengthen the conclusions derived from the more positive experiments previously recorded.

At Town Creek, one-quarter of a mile southeast of the town, Mr. A. A. Owens made the test on what he describes as white sandy land with yellowish subsoil. There was no rust, but drought. This experiment was undertaken by Mr. R. R. Reed, who turned the fertilizers over to Mr. Owens. The test is inconclusive for the reason of the tearing of one of the fertilizer sacks, probably that for plot 9.

The Newtonville experiment in Fayette county was made by G. W. Gravlee, but was vitiated by late germination and irregular stands.

The experiment at Hanover, Coosa county, was made by J. M. Logan on gray gravelly or rocky land with red clay subsoil. The results suggest that kainit was not needed.

The test one mile east of Fredonia, Chambers county, was made by E. W. Smart on dark upland with red subsoil. Inequalities in stand, due, he reports, to disease of the young

plants, vitiated the experiment. The results suggest that a mixture of cotton seed meal and acid phosphate was sufficient. Cowpeas in corn or after oats, and grazed, grew on the land in each of two years preceding the experiment.

Mr. W. A. Candler, Clanton, Chilton county, made the experiment on land where the preceding winter he had plowed in a very rank growth of cowpea vines, affording conditions unsuitable for a test of commercial fertilizers.

At Wetumpka, the test was made on the farm of the District Agricultural Schools with conflicting results both in 1902 and 1903.

At Greensboro the tests were made by T. K. Jones, 1 1-2 miles south of town on poor red upland, originally covered with hardwood. In 1902 manure was accidentally added to certain plots, and in 1904 the growth of grass ruined the experiment.

Four miles north of Union Springs Mr. N. Gachet made a test on light, reddish loam with red clay subsoil, where the original growth had been hardwoods. Variations in the stand destroyed the value of the experiment.

The test at Carson, Washington county, was consigned to Mr. R. D. Palmer. It was made on gray upland, pine land with yellow clay subsoil, two miles north of Carson. The results are somewhat conflicting.

For the Geneva experiment, see page 66.

Credit is due Mr. C. R. Hudson for making or checking all calculations in this bulletin.

*Town Creek, Newtonville, Hanover, Fredonia, Clanton and Wetumpka experiments.*

FERTILIZER.	TOWN CREEK 1904		NEWTONVILLE 1904		HANOVER 1902		FREDONIA 1904		CLANTON 1904		WETUMPKA 1902		WETUMPKA 1903		
	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	
Amount per acre.															
1 200 Cotton seed meal	Lbs.	232	40	123	69	328	152	496	56	1320	648	248	648	76	648
2 240 Acid phosphate	"	248	56	222	168	376	200	656	216	1376	760	48	776	00	248
3 000 No fertilizer	"	192	00	54	00	176	00	440	00	1568	712	00	00	00	00
4 200 Kainit	"	232	44	68	6	248	45	720	216	1696	656	14	768	240	240
5 200 Cotton seed meal	"	348	162	234	164	536	366	899	328	1456	648	19	1040	512	512
6 240 Acid phosphate	"	416	233	96	18	360	102	824	192	1472	754	167	816	288	288
7 200 Kainit	"	392	213	174	88	320	35	944	248	1472	744	198	56	32	32
8 000 No fertilizer	"	176	00	94	00	312	00	760	00	1592	504	00	528	00	00
9 240 Cotton seed meal	"	368	192	184	90	296	16	1008	248	1384	632	128	672	144	144
10 240 Acid phosphate	"	418	232	247	153	352	40	1048	288	1376	552	48	888	360	360
100 Kainit	"														

## Greensboro., Union Springs, Carson and Geneva inconclusive fertilizer experiments.

Plot No.	FERTILIZER.	AUBURN 1904		GREENSBORO 1902		GREENSBORO 1904		UNION SPRINGS 1904		CARSON 1904		GENEVA 1903	
		Amount per acre.	KIND.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.	Yield of seed cotton per acre.	Increase over unfertilized plots.
		Lbs		Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
1	Cotton seed meal	200	928	120	352	96	228	00	00	856	112	696	112
2	Acid phosphate	240	1136	40	328	72	72	552	72	728	-16	744	160
3	No fertilizer	00	1096			00	00	480	00	744	00	584	00
4	Kainit	200	956	-20	256	00	18	512	18	728	-14	560	-53
5	Cotton seed meal	200	1256	392	376	120	82	712	203	904	163	896	254
6	Acid phosphate	240		60	304	48	53	640	117	824	84	864	199
7	Cotton seed meal	200	812										
8	Acid phosphate	240	720	80			-18	544	6	776	38	712	12
9	No fertilizer	00	536				00	552	00	736	00	728	00
10	Cotton seed meal	200	848	312			80	448	-104	888	152	768	40
11	Acid phosphate	240	960	424			164	528	-24	1072	336	1016	288
12	Kainit	100					248						

*Compliments of*  
*E. Mead Wilcox*  
*N.T.*  
BULLETIN NO. 132.

APRIL, 1905.

ALABAMA



# Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

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Diseases of the Apple, Cherry, Peach, Pear and Plum;  
With Methods of Treatment.

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By

E. MEAD WILCOX, PH. D. (Harvard)

Plant Physiologist and Pathologist.

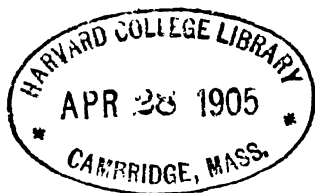
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*The Bulletin*

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

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ADDITIONAL LIBRARY

## INTRODUCTION.

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The rapid increase in the fruit growing industry in this State within recent years has made it necessary that more and more attention should be given to the diseases of these plants by the Experiment Staation and the fruit-growers themselves. A large number of letters reach this department during the year asking for information regarding these diseases and the best method of controlling them and these letters cannot in most cases be properly replied to by letter alone. They indicate also a growing interest in these matters and seem to indicate that the time has arrived to place before our people such information as is now available regarding these matters. To supply this evident need this Bulletin has been prepared.

We have thought it best to depart somewhat from the common method of presenting such matters and have made the attempt to arrange the facts and suggestions under such definite headings as will best serve to indicate what sort of information must be had before one can hope to successfully control diseases of cultivated plants. More than this we have looked upon the diseases from the standpoint of the diseased plant and have included, therefore, no statements regarding the organism causing the diseases where this would not conduce to a clearer understanding of the disease itself and particularly of the methods of treatment suggested. The science of plant pathology owes much to mycology but its future advance and recognition depends upon its rather more sharp differentiation from "economic mycology."

The plants are arranged in alphabetical order by their common names and under each are given, also in alphabetical order, the most important diseases of these

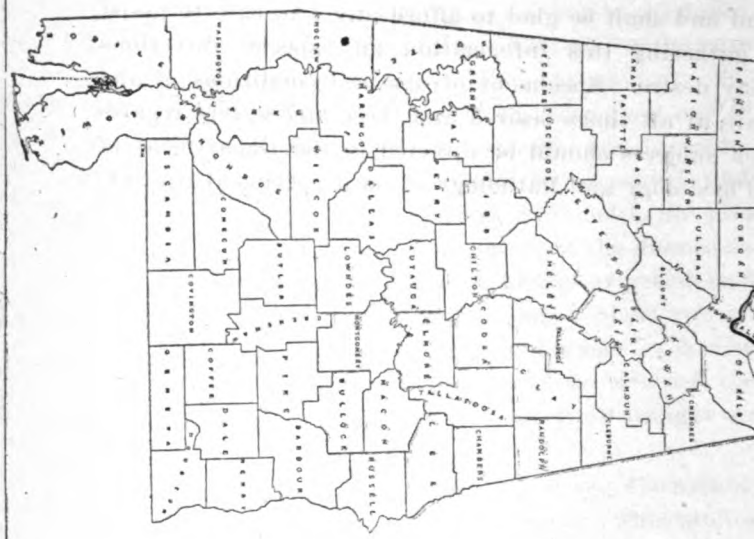
plants in our region. We have introduced no new common names for any of these diseases, but have employed the common names now in most common use or that are sanctioned by the leading authorities upon this subject. In cases where the same disease is known on more than one of the plants mentioned reference to the disease will be made under each, but its full description will be presented under the first plant mentioned or in connection with the plant in which the disease is here best known. If the disease shows specific differences in the different plants attacked mention of the facts will be recorded under each plant concerned. Methods of treatment are discussed under each disease and no "spray calendar" is given. It is believed the plan here adapted has several and peculiar advantages over the other method.

We have placed at the close of the discussion of each disease a bibliography of the disease. This bibliography is in no case complete, but is simply a select list of the more original and recent literature dealing with this subject. The majority of these references are to the literature of the State Experiment Stations and the Department of Agriculture. To these and other sources I am indebted for information here presented and the references to this literature are here included to show readers of this Bulletin that further reading and study of this matter of plant diseases may readily be made in the publications mentioned that may in most cases be had for the asking.

One of the principal purposes of this Bulletin is to enable fruit growers to recognize some of the common diseases of the plants mentioned in order that they may assist this department in securing data each year of the distribution and severity of the diseases in the various counties of the State. The method employed here in recording this information is well shown by the figures on pages 82 and 83. The first one shows the front and the last one the back of a record form so made as to be employed in a regular loose

leaf holder. We wish specimens and information regarding each disease from every county of the State where it is to be found and shall be glad to afford any who care to assist us in gathering this information any special directions they may desire. Specimens of diseased conditions of any plant are at all times desired and these and letters regarding such subjects should be directed to the Department of Plant Physiology and Pathology of the Experiment Station.

(Devised by E. Mead Wilcox, 1904.)



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## BITTER ROT.

### HISTORY AND DISTRIBUTION.

The bitter rot of apples, known also as the ripe rot or anthracnose of the fruit, certainly made its appearance in America previous to 1867 and has attracted much attention from that time to date. In the United States the disease is found in practically every State east of and including Kansas, Oklahoma and Texas; the most serious outbreaks of the disease have occurred in Oklahoma, Indian Territory; southern Illinois, Ohio and Indiana; Kentucky, West Virginia, Virginia, eastern North Carolina, western New York; Delaware, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New Jersey and Alabama.

The fungus causing this disease may be fairly said to be found the world over wherever the apple is grown and, in addition to the apple, has been found on the following hosts: pear, tomato, grape, peach, nectarine, apricot, pepper, egg plant and squash. It remains to be determined whether the fungus occurring on these various hosts is identical.

### SYMPTOMS.

The bitter rot or ripe rot of apples is a fungus disease of the ripening fruit producing in another form a canker of the smaller limbs of the apple tree.

The first sign of the disease is to be found in the form of a small discoloration just beneath the skin of the apple. This spot, as it enlarges, becomes more and more sunken and the rotting of the apple proceeds towards the core. When the spots reach a size of about a half inch in diameter small blackish bodies appear in a circular arrangement beneath the skin of the apple (Plate I, Fig. 1.). These blackish

bodies are the fruiting bodies of the fungus and soon project from the surface of the diseased spot. As these fruiting bodies break through the surface of the apple the spores produced in them are allowed to escape. The spores are held together in the form of stringy pinkish masses which are quite conspicuous, particularly on dry quiet nights when the spore masses are oozing out.

As the disease progresses other rings of fruiting bodies will appear outside of the one first formed and in time there may be a half dozen or more of these concentric rings. If the climatic conditions are unfavorable to the rapid development of the fungus the rings of the fruiting bodies will not be so definite or may be absent entirely. From the original point of infection the fungus may grow out until the whole apple is rotted—though there is at all times a rather sharp line of separation between the healthy and diseased portions of the fruit. If infection occurs at more than one point the rings of fruiting bodies from the several infections will ultimately unite with one another.

The general effect of the fungus is to hasten the maturity of the apple and lead to the well known falling of the apples. This falling may occur at any stage in the development of the disease. In fact the premature falling of the fruit is one of the most conspicuous symptoms of this disease.

During the summer of 1902 a Mr. Simpson, of Illinois, a large fruit grower of that State, noticed that in many cases there was to be found a canker on the limb that he suspected of being the source of infection from the fact that the canker was often found at the top of an inverted cone formed by the diseased apples on the tree. A careful investigation of this matter by Blair and Burrill and by Von Schrenk and Spaulding has established this suspicion of Mr. Simpson as a fact. They were able to produce the typical bitter rot by inoculation of healthy apples with spores produced in these limb cankers and also to produce the limb canker through inoculation with spores obtained from dis-

eased apples. This very important discovery introduced into the treatment of the disease a new factor of immense importance.

These cankers appear most generally on the smaller limbs and their general appearance is well shown in Fig. 2 on Plate II. There are other cankers of apple trees and of other trees due to various causes, but whenever the bitter rot of apples is found on trees on which cankers like those shown in the above figure occur the removal of the cankers would be advisable even in advance of a demonstration of the connection between the two troubles.

#### RELATIONSHIP OF DISEASE TO CLIMATIC CONDITIONS.

The first appearance of the trouble on the apple may be expected during July in this latitude, though in the northern apple growing districts this is generally delayed until August. The exact time depends much upon the climatic conditions that prevail at the time and during the spring.

The green fruit is generally quite immune, a fact that may be due to the larger amount of malic acid in immature fruits as compared with ripe fruits. And it is this rapid destruction of the ripe fruit just when the owner is about ready to gather in the crop that makes the trouble so much dreaded!

Warm and sultry weather affords the best chance for the rapid development of the fungus and the appearance of a regular bitter rot epidemic. On the contrary in cool dry summers the trouble need not be much feared. Nights with much dew alternating with hot days will greatly promote the development of the fungus.

The time of first appearance of the trouble on the fruits may also be much influenced by the condition of the spores, as to ripeness, in the cankers and the mummies, to be described later. If a cold spring has delayed the formation of these spores then the rot will be late appearing on the fruit itself.

## ECONOMIC IMPORTANCE.

We cannot do better to emphasize the importance of this disease than to mention the statement of the President of the National Apple Shippers' Association who said, "the damage to the apple crop of the United States in 1900 from bitter rot was \$10,000,000.00." The destruction of 75 per cent. of the crop by this disease is not very unusual and in many cases the owners of apple orchards have preferred to lease the orchard for a mere trifle than to run the risk of getting no returns at all. Von Schrenk and Spaulding say, in speaking of this disease, that "It has probably done more to discourage apple growing in many regions than all other troubles, including both fungus and insect diseases combined." In our State the disease has caused great losses in many places, but so far no very systematic attempt has been made to control the disease or to determine its exact distribution.

## AETIOLOGY.

The bitter rot of apples and the associated canker of apple limbs are produced by the fungus now known as *Glomerella rufomaculans* (Berk.) Spaulding and Von Schrenk.

## REMEDIAL MEASURES.

The treatment against this disease may, in the light of our present knowledge, be grouped under three headings: (1) removal and destruction of all diseased apples from the tree and from the ground, (2) removal of the cankered limbs, and (3) spraying with the regular Bordeaux mixture as directed below.

The spores formed on the apples that fall to the ground during the season and those on the apples that dry up to form mummies on the tree may live over the winter and thus constitute sources of new infection during the following spring. If only a few trees are infected it will cer-

tainly pay well to watch the spread of the disease and immediately pick and destroy by burning or burying in the ground every apple as soon as the disease appears upon it. In this way the further spread of the disease to other trees in the orchard will be largely prevented. And then all rotten apples on the ground should be gathered up and destroyed.

The limb cankers should be removed during the late fall or winter as they can then be seen more readily than they can when the trees are in leaf. If cankers are found on the smaller limbs as is generally the case, these limbs may be removed entire, but if found on the trunk or very large limbs it may be best to carefully cut out the cankered portion and paint over the wound carefully with white lead paint or tar. It seems certain now that the removal of all these cankers will do much to lessen the spread of the disease in the orchard by removing one of the sources of new infection.

In addition to the two above named precautions the trees should be carefully sprayed with Bordeaux mixture at least once before the buds open and then at intervals of ten days until the fruit is about ripe.

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### BLACK ROT.

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This disease has been known for some time being reported from Illinois for example as early as 1878. It probably occurs in every apple orchard and is often confused with the bitter rot.

### SYMPTOMS.

Brownish decayed spots appear on the apple generally near the stem and often near the flower end. This rotted area soon turns black and the rotting proceeds towards the center of the apple. There is no such sharp demarkation between the rotten and healthy portions of the apple as exists in the case of the bitter rot and this is one method of distinguishing the two diseases from each other. The surface of the decayed spot becomes somewhat depressed.

Finally the apple shrivels up more or less and becomes a small and hard "mummy."

This disease does not occur as a rule on green apples except in cases of injury to the apple by wounds or insects. It is often abundant on "windfalls." It is also one of the chief causes of rotting of apples in the market.

On the leaves the same fungus often causes rather serious damage through the formation of rather large and irregular brownish spots.

The old dead twigs on unpruned trees may often become breeding places for this fungus from which spores may be scattered by the wind. The fungus was once thought to live on the twigs merely as a saprophyte but is now known to cause a serious canker of apple twigs. (See Canker of Apple on page 91.)

#### AETIOLOGY.

It is produced by the fungus *Sphacopsis malorum*, Berk. The fruiting stage consists of numerous rather small black pustules that develop on the surface of the diseased apple. The pustules develop as a rule only after the rotting is fairly well advanced.

These pustules are roundish conceptacles, with black or purplish walls, containing the spores. The spores ooze out as small white threads. The spores are at first white, but soon become deeply colored.

#### TREATMENT.

The disease may be controlled by spraying with Bordeaux mixture, making the first application before the leaves appear and subsequent ones at intervals of about two weeks. (See Fig. 6 on Plate II.) Decayed fruit should be removed from the trees and the ground and destroyed and "mummy" fruits should not be allowed to remain on the tree over winter.

Since the fungus causing this disease is also shown to

be the cause of a canker, care should be taken to remove or treat cankered limb as suggested under the bitter rot.

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### CANKER.

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#### HISTORY AND DISTRIBUTION.

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This disease was first reported from New York State, but is now known to have a much wider distribution. The fact of its being caused by the fungus producing the well known black rot of the apple, pear and quince fruits would naturally lead one to suspect that the distribution of the canker would be coextensive with the black rot.

#### SYMPTOMS.

In general a canker may be said to be the result of any "injury that destroys the bark and lays bare portions of wood." (Bull. 170 N. Y.) This particular canker is due to the action of a parasitic fungus that attacks principally the larger limbs. The trouble may be detected from the swollen appearance of the limbs and the rough dark colored bark. (Plate VII. Fig. 19.) Frequently in severe cases of canker the wood itself may be exposed and thus decay of the wood itself begins. The extent to which the canker affects the bark varies apparently with various conditions, but may be several feet.



The effect upon the tree is due to the interference with the circulation of the sap and the amount of injury will of course be in proportion to the surface area of the cankers. The tree may be simply weakened or may be killed outright.

#### AETIOLOGY.

This canker is caused by the fungus *Sphaecropsis malorum* Pk.

#### TREATMENT.

Cankered limbs should, if possible, be removed and burned. Where the cankers are found on the trunk or very large limbs it may be advisable to cut out the diseased spot and paint over the wound with some sort of paint or wash.

When spraying with Bordeaux mixture for other apple diseases if canker be present it would be advisable to thoroughly cover the limbs with the spray mixture.

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### FLY SPECK.

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#### HISTORY AND DISTRIBUTION.

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This disease, often referred to as “flies” and “blackbirds,” was first reported in scientific literature in 1896 from Delaware. It is at present no doubt to be found practically wherever the apple is cultivated.

#### SYMPTOMS.

This fruit-disease is marked by the appearance upon the fruit of a number of small spots of specks (Plate II. Fig. 5.) in areas that may be 1-4 of an inch or more in diameter. The skin of the apple around this area may become rather cloudy in color and if many of the areas unite with each other the whole surface of the apple may become sooty in appearance. The effects of the fungus do not extend below the surface of the apple, but in the most severe cases the apple may become somewhat shrivelled owing to the action of the fungus causing the disease.

The claim is made that the disease will spread upon apples in storage.

#### ÆTIOLOGY.

The disease is due to the fungus known as *Leptothyrium pomi* (Mont. & Fr.) Sacc.

### RESISTANCE OF VARIETIES.

This disease appears in ordinary seasons most severely upon the fruit of trees planted in low damp situations. During a very wet season, however, all sorts of trees will be apt to be affected without reference to their situation or resistance. Rhode Island Greening, Rome Beauty and Peck's Pleasant are very frequently badly injured by this disease.

### TREATMENT.

One thorough spraying with the ordinary Bordeaux mixture when the apples are half grown or less will prevent the injury from this disease. In the case of smooth skinned apples this spraying should be done somewhat earlier to prevent the so-called "russetting" of the apples caused by the fungicide itself. See also treatment for sooty blotch.

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### HAIRY ROOT.

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### HISTORY AND DISTRIBUTION.

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This disease was first reported by Stewart, Rolfs and Hall from Western New York in 1900, but is no doubt much more

widely distributed than our records in the literature show. We have here in Alabama a very similar if not identical disease of apple and peach.

#### SYMPTOMS.

The affected trees have few or no large branch roots. The root system of the tree instead consists of a number of groups of hair-like fine roots springing from the main tap root. Fig. 16 on Plate VI shows one of the common forms of the disease.

#### AETIOLOGY.

The cause of the disease is at present unknown. It may be associated with attacks of wooly aphis or with the crown gall, but may occur independent of both of these troubles. It does not seem with us to be found associated with any type of soil. Specimens of this disease are much wanted.

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### RUST.

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#### HISTORY AND DISTRIBUTION.

Apple rust is widely distributed and may be expected wherever apples and cedar trees are growing in close proximity to each other. In Alabama the rust is in many sections one of our most serious apple troubles.

#### SYMPTOMS.

The disease may readily be detected by the circular yellowish spots (See Fig. 4 on Plate II.) that appear on the

leaves in May or June. Similar spots may also appear on the fruit.

#### AETIOLOGY.

The apple rust here is produced by one stage of *Gymnosporangium macropus*, the other stage of which lives on the red cedar causing there the so-called "cedar apples," shown in Fig. 3 on Plate II. The spores produced in the gelatinous out growths from these galls in early spring are the source of infection of apple leaves.

#### TREATMENT.

Spraying seems to be of no value in controlling this disease. Since cedar trees harbor one stage of the fungus causing this disease it is of course advisable to remove the "cedar apples" or if possible the cedar trees themselves. A little attention to this matter will dispose of the rust problem in apple orchards.

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## SCAB.

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### HISTORY AND DISTRIBUTION.

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It has been known as a serious apple disease since the early part of the 19th century. For example Curtis recorded it as common on apples in North Carolina in 1867. In this country its greatest injury seems to be in the Mississippi Valley. In this State no definite attempt has ever been made to the writer's knowledge to control it by spraying and in fact it has never attracted any great attention.

### SYMPTOMS.

Scab first makes its appearance early in the spring soon after the first leaves begin to unfold. It is during this time that the greatest amount of infection occurs, though there is a second period of infection in the fall which is largely responsible for the production of the mature winter stage. The scab may often be seen on the leaves and fruit of the lower branches showing that the probable source of infection was to be found in the leaves on the ground on which the fungus had wintered over. The first spots on the leaves are often on the lower side near the midrib—this being the first part of the leaf to be exposed while the leaf is unfolding.

### ON THE LEAVES.

The scab here is found in the form of roundish spots about 1-4 inch in diameter. Frequently several of these spots may unite with one another—particularly if they are near a large vein or the midrib where the fungus seems to grow more rapidly than elsewhere on the leaf. The spots have an olive green color.

## ON THE FRUIT.

The scab spots are roundish 1-8 to 1-2 inch in diameter and of an olive green color—frequently with a lighter colored margin. These spots may coalesce to some extent if conditions are such as to favor the growth of the fungus. The scab fungus grows more rapidly on young fruits than on older ones—due no doubt to the fact that the cuticle of the younger apples is more delicate. Old fruits for the same reason are not very apt to become infected. The cuticle over the “scab” may later in the season become broken and flaked off, exposing the dead tissues of the apple and giving the scabbed area a reddish brown color. The fungus also frequently causes the formation of a considerable amount of corky tissue—which in turn protects the apple from becoming infected at the scab spot by other fungi.

## WINTER STAGE.

When the diseased leaves fall to the ground in the fall the mycelium that during the summer was confined to the space just beneath the cuticle, grows down into the tissues of the leaf. The deeper penetration into the leaf is made possible by the death of the leaf and the consequent partial decay of its tissues. These hyphae take on a reddish olive color and the cells composing them are larger than those formed during the summer. The fruiting bodies, perithecia, of the fungus are formed within the leaf. The spores are ripe by April or May and ready to produce the spring infection. Perithecia are often formed near the small spots on leaves produced by the autumn infection. The pustules are scattered or more generally gathered together in groups on a grayish spot that may mark the spot of the summer's scab. This stage of the fungus is not found elsewhere but on the leaves.

## TREATMENT.

The scab may be prevented by spraying with Bordeaux mixture as follows:

- (1.) Spray with Bordeaux mixture just before the flower-buds open.
- (2.) Spray again just after the blossoms fall.
- (3.) Spray 1, 2 or 3 more times at intervals of about 10 days.

The following results secured by Jones & Orton in Vermont, show the immense profits in spraying for the apple-scab. They sprayed as follows:

1. April 27. Buds not open; with solution of copper-sulfat 1 lb. to 20 gallons.
2. May 18. Leaves out—flowers not open; Bordeaux "1—10" to which was added 1-3 lb. paris green.
3. June 15. Blossoms fallen.
4. July 18.
5. August 3.

Comparison was made of trees sprayed five times and those sprayed three times (the last two sprayings being here omitted) and trees not sprayed at all. The following table shows the results clearly:

	Per cent. on the tree.	Per cent. fallen.	Total value of crop per tree.
Sprayed 5 times .....	60	40	\$15.44
Sprayed 3 times ....	51	49	7.38
Not sprayed .....	33	67	2.15

When account is taken of the fact that the fungus causing the disease may winter over on the fallen leaves it appears advisable to rake up and burn fallen leaves at the close of the season.

The gain from spraying may fall into the following classes:



- (1.) Actual gain in yield per tree.
- (2.) An increased percentage of "selects" and No. 1." apples.
- (3.) Prevention of falling due to scab .
- (4.) Increase in vigor of the tree itself.
- (5.) Reduction of the loss, often very serious, resulting from the attacks of various fungi causing a rotting about the scab spots of storred apples.

#### INFLUENCE OF WEATHER.

The greatest injury from the scab may be expected during seasons having a cold damp spring. The amount of the injury in any given season is also no doubt in a measure dependent upon the amount of the mature *Venturia* stage produced on the fallen apple leaves—this in turn being influenced by the climatic conditions prevailing during the preceding fall and winter.

#### AETIOLOGY.

Apple scab, a disease affecting the leaves and fruits of the apple, is caused by the parasitic, summer stage, *Fusicladium dendriticum*, of the fungus *Venturia inaequalis*.

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## SOOTY BLOTCH.

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### HISTORY AND DISTRIBUTION.

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This was first reported by Sturgis in Connecticut in 1898 on Rhode Island Greenings and Newton Pippins. It is now very widely distributed and together with the fly-speck disease, with which often associated, causes much damage to apples particularly during wet seasons or where trees are planted in low damp soil.

### SYMPTOMS.

The disease appears as irregular blotches (Plate II. Fig. 5.) upon the surface of the apple—these blotches are at first pale, but soon become sooty black in color and under a lens show a radiating appearance due to the manner of growth of the fungus causing the disease. No rotting of the fruit occurs since the fungus works entirely upon the surface of the fruit. It may with the fly-speck disease greatly reduce the market value of the fruit.

### TREATMENT.

Both fly-speck and sooty blotch will be controlled by the

spraying against the scab. It may be necessary, however, to give one or two sprayings later in the season, say in July.

#### AETIOLOGY.

The fungus causing this disease is generally referred to *Phyllachora pomigena*, though this matter demands further study.

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## CHERRY.

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### BLACK KNOT.

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#### HISTORY AND DISTRIBUTION.

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Black knot has long been known and the extent of its injuries has frequently been brought home to plum and cherry growers in no uncertain manner. The plum industry of the famous Hudson river valley (N. Y.) was practically wiped out by this disease. Farlow, 1876, was the first to determine its exact cause concerning which the most various opinions had previously been entertained.

Its most serious injury has frequently been to plums, but cherries are by no means exempt. DeSchweinitz mentions

an epidemic of this disease that destroyed the cherry trees about Bethlehem, Pa., in 1790.

#### SYMPTOMS.

The black knot is a rough wart-like outgrowth (Plate VII. Fig. 18,) from the bark of twigs and branches in severe cases extending along the trunk for several feet. The first symptom is the swelling of the tissue just beneath the bark. This enlargement increases during the fall or growing season until the bark is ruptured. This exposed portion of the twig is soon covered with an olive green velvety coating composed of the reproductive hyphae of the fungus. A microscopical examination of the diseased portion at this time would show numerous erect hyphae bearing spores—the so-called summer spores. These are readily carried about by the wind and other agencies and serve to spread the disease during the growing season.

Later in the season the production of summer spores ceases and the velvety covering gradually disappears. The surface of the wart gradually becomes hardened and altered in color to a dark brown and finally to a dead black.

Pimples may be seen late in the fall covering the wart. In these are developed the winter spores called ascospores. These ascospores only develop during the winter and are capable of germination in February and March.

#### AETIOLOGY.

The disease is due to the fungus *Plowrightia morbosa*.

#### TREATMENT.

The diseased twigs should be removed after leaf-fall or before the winter spores are formed. Twigs that show in the spring or early summer the beginning of a "knot" should be removed and burned to prevent the formation of the summer spores. If such knots are simply cut off and allowed

to remain on the ground the summer spores may ripen and then be scattered to other trees.

Co-operation of entire neighborhoods must be secured to render the campaign against the black knot effective. Legislation has been resorted to in several States, but a healthy and intelligent public opinion is necessary in this as in many cases.

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### GUMMOSIS.

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Among the stone fruits such as cherry, peach and plum a "gum-flow" or gummosis is frequent and may become a serious menace to the life of the trees affected. This disintegration of the tissues of the affected plant may be brought about by a variety of causes. Hence gummosis is a generic term applied to the condition here described whatever be the cause. Massee has described a gummosis of the common flowering almond (*Prunus japonica*) due to the action of a parasitic fungus, and this seems to be the only case of gummosis so far demonstrated to be due to a parasitic fungus.

Excessive gum flow frequently leads to the formation of a canker. (See plum canker, page —.) Reports of outbreaks of gummosis in any of the trees mentioned will be gladly received.

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### LEAF SPOT.

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### HISTORY AND DISTRICT.

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This disease occurs widely distributed on the leaves of cherry, plum and apricot and is frequently referred to as leaf blight.

## SYMPTOMS.

Minute spots at first appear soon after the first leaves are full grown and these are often only 1-6 inch or less in diameter. On cherry and plum leaves the spots may have a reddish margin. The spots enlarge to 1-8 inch or more in diameter, (See Fig. 21 on Plate VIII,) becoming at the same time dark and with a pale center. Often the diseased spots fall out of the leaf causing a shot-hole effect and then called "shot hole" disease. (See Plate VIII.)

The tree may become defoliated through the action of this disease and in that case may be much weakened so that it is more apt to be injured during the following winter. The damage in this direction is much greater if the defoliation occurs, as it is apt to in the plum, when the tree is in fruit.

## AETIOLOGY.

This disease is caused by *Cylindrosporium padi*.

## TREATMENT.

The leaf spot may be controlled by the proper spraying with Bordeaux mixture, but in the case of the cherry the application of the spray at the time the tree is in fruit, the best time to control the disease, may cause the fruit to be stained with the spraying mixture so as to reduce its market value. However, it is well to apply Bordeaux just before the blossoms open and again just after they fall to partially control the leaf spot and fruit rot.

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## PEACH.

### BROWN ROT.

#### HISTORY AND DISTRIBUTION.

It has been known as a serious enemy of the peach in the United States for over 20 years and in Europe for even longer. Whenever peaches, plums or cherries are grown in this country the brown rot is a most serious pest. During certain years the loss is made most noticeable by favorable weather conditions. Thus in 1900 the loss to the peach crop in Georgia was estimated to be 40 per cent. or from \$500,000 to \$700,000. Similar losses are reported from other places. In Kentucky it has been reported as a rather serious disease of apples, but with us it seems to be confined to the peach, plum and cherry. It has also been reported on the pear, quince and apricot in addition to the above.

#### SYMPTOMS.

##### ON THE FLOWERS.

Under favorable climatic conditions the disease may attack the flowers before or after the petals have fallen. At first a slight discoloration will appear on some part of the flower and soon this spreads so as to give the whole flower a brown and withered appearance. In Alabama during 1897 an epidemic of this disease of the peach flower appeared that practically destroyed the peach

crop for that season. Foggy, rainy and very warm weather were the conditions then prevailing that made possible the germination of an unusual number of the spores, derived, as usual, from the old diseased "mummy" fruits adhering to the trees. The spores formed on the diseased flowers were then sources of infection for any fruit that was later developed.

#### ON THE TWIGS.

On the peach and plum, particularly the peach, the mycelium of the fungus may grow down into the twigs from the flowers or fruits that are infested. This condition of affairs is often referred to as the "twig-blight" of the peach. (See also canker of plum on page 131.) If only one or two peaches are found on a twig the twig is apt to become infected at only one point and thus be girdled by the fungus, resulting in the death of the uninfested terminal portion of the twig. If several infested fruits occur on the twig it may become infested throughout its entire length.

#### ON THE FRUIT.

Small brown spots appear—these rapidly enlarge and whitish tufts of spore-bearing hyphae may appear. The peach may fall to the ground or simply shrivel up and remain attached to the tree. (See Plate III.)

In the case of the plum the fruit may be infected for some time before any external evidence appears. As the plum begins to ripen, however, the ash grey tufts of spore-bearing threads appear. This difficulty of distinguishing between infested and healthy plums leads in many cases to serious losses in shipping these fruits.

Peaches also often suffer en route to market from this rot—particularly if the refrigeration is not properly attended to.

## TREATMENT.

The brown rot can be effectually controlled by two lines of treatment: (1) spraying with Bordeaux mixture as explained below and (2) removal and destruction of all affected fruit from both the tree and the ground.

The trees should be sprayed with the Bordeaux mixture as follows:

1. Just before the buds open.
2. Just after the blossoms fall.
3. Ten days to two weeks later.
4. Keep the fruit covered with the Bordeaux mixture until ripening begins and then employ either the ammoniacal copper carbonat or a solution of dibasic copper acetat made by dissolving six ounces of the salt in fifty gallons of water. These two mixtures will not injure the fruit.

Too much stress cannot be placed upon the absolute necessity of removing from the tree all the diseased fruits since these are sources of infection and their presence upon the tree may lead to most severe attacks of the twig disease produced by this same fungus. The fruits that are allowed to fall to the ground after rotting may serve as the home of the perfect stage of the fungus and act as sources of infection during the next spring. Mummy fruits (Fig. 8 on Plate III.) should not be allowed to remain on the tree.

## AETIOLOGY.

The brown rot is caused by the fungus now known as *Sclerotinia fructigena*—the conidial or imperfect form of the fungus, however, known as *Monilia fructigena*, being the direct cause of the disease. The perfect form of the fungus has been found on old fallen peaches in Maryland and Georgia. Its discovery emphasizes the necessity of removing and destroying all fallen and mummy fruits.

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## CROWN GALL.

### HISTORY AND DISTRIBUTION.

Crown gall is a contagious disease affecting a considerable number of the smaller and larger fruit trees and plants. The disease has been reported upon the following plants: peach, almond, apricot, prune, plum, pear, apple, English walnut, raspberry, blackberry, cherry, poplar and chestnut. It is, however, not at all certain that the galls on all the above plants, though very similar in general appearance, are caused by one and the same organism.

### SYMPTOMS.

The gall generally behaves as an annual growth—those that begin in the spring mature the same fall. But in this climate the galls that start in late summer or fall continue their growth through the winter season. It is strictly a nursery disease—seedlings 1 to 6 months old being most likely to become infected. The first gall in such cases generally appears on one side of the main root a few inches below the surface or near the “crown” of the seedling. On larger trees the galls generally appear on the lateral roots though the crown is also commonly attacked in the case of large trees. (Plate V.)

The wart at first is a light colored clear or translucent mass of succulent tissue frequently attached to the plant by means of a slender stalk or neck. The galls grow very rapidly and the outer surface soon takes on a warty appearance and a reddish brown color. The parts of a gall that become dark colored have lost their power of growth—the discoloration being due perhaps to the action of various fungi attacking the gall. From the surface of such a discolored gall many new smaller outgrowths may appear.

Toward the end of the season the gall becomes badly decayed and may readily be broken away from the plant leav-

ing an ugly deep wound. During the following spring a new lot of gall growth may take place around the margin of the old scar. And if the gall be removed new growth may begin even in the center of the wound thus formed. (Fig. 14 on Plate V.) This process may continue until the resulting wound is so deep that the tree falls of its own weight.

If a section of rapidly growing gall be examined there will frequently be found through it numerous darker colored irregular spots that are centers of more rapid growth. These centers frequently become beautifully twisted nodules of woody tissue—after the gall matures and begins to decay many of these curious nodules may readily be removed from the outer portion of the gall.

#### SPREAD OF THE DISEASE.

The disease has been widely scattered over the country by shipments of stock from infested nurseries.

Locally it is known that a single diseased tree may in a few years suffice to infect most of the trees in the orchard. The spores of the parasite are small and may be carried by the air and it is likely that the disease may be communicated from old decayed galls.

The careless wounding of the crown of a tree or the break in the bark produced by escaping "suckers" both make a pathway for the parasite to gain entrance into the tree.

Care should in all cases be taken to see that all removed galls and uprooted diseased trees be burned on the spot and not hauled through the orchard at all.

#### AETIOLOGY.

Toumey in Arizona gave special attention to the crown gall on the almond and described as the cause of this disease a new species of slime mould which he called *Dendrophagus globosus*. As has been said it has never been demonstrated that this organism is the cause of the widely dis-

tributed crown gall on the various plants that were mentioned above. Toumey was able to communicate the almond disease to the peach and apricot, but failed to do so to the apple. Selby believes that the gall may be communicated from the raspberry to the peach, but Halsted came to the opposite conclusion. Much work remains to be done on this very important disease.

#### TREATMENT.

The best advice that can be given fruit growers relative to the crown gall is this—never plant trees from a nursery known to be infested with the disease and never plant trees showing the disease. If a diseased tree is planted it is practically certain that the tree will never amount to anything. And what is even more important one is thereby very likely to introduce the disease into the soil of the orchard. If a bundle of nursery stock has a single crown gall on any of the trees the whole lot of trees should be destroyed.

It is possible that some good may be done by inspecting the orchards annually and removing all galls that have formed at the crown of the trees. After carefully cutting away the gall the wound surface should be covered with a paste made of lime and blue vitriol. But it must be remembered that, though the galls at the crown do the most damage, the smaller galls on the roots, which cannot be removed after planting, will reduce the vitality of the tree. It is therefore certain that no amount of after treatment of any sort will make a diseased tree give as large a yield as a healthy one.

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## LEAF CURL.

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### HISTORY AND DISTRIBUTION.

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The leaf curl of the peach is found practically wherever the peach is cultivated and is one of the most serious of all peach enemies. The total losses from curl in the whole United States have been estimated by Pierce to be as high as \$3,000,000.00 in a single year.

### SYMPTOMS.

As soon as the young leaf buds begin to open the leaves

show the characteristic roughened surface and deeper green color. This "curling" of the leaves progresses rapidly as the leaves grow (Fig. 9 on Plate IV). A part only or all of the leaf blade may become affected. A mature leaf, affected with curl, may have a reddish color, but generally the diseased leaves become simply discolored.

The fungus also grows inside the terminal portion of the young twigs and causes these to become swollen and to take on a lighter, paler color. These swollen terminal portions of the twigs constitute the only home of the perennial portion of the fungus. The spring infection seems to take place largely from spores formed from the mycelium present in these swollen twigs. The leaves soon become covered with a greyish mealy coating—composed of the fruiting bodies of the fungus. The spores are produced in small sacs arranged parallel to each other and at right angles to the surface of the leaf. These asci are produced on the ends of hyphae that grow out through the epidermis of the leaf. Defoliation occurs soon after spore-formation.

Gummosis of affected twigs is frequently to be seen as a result of the action of this fungus.

The tree attempts to make up for the loss of leaf surface by forcing some of its dormant buds to grow—these buds may grow to give a healthy twig—but at the base will be left the swollen fungus-infested portion—constituting a dangerous source of infection for another spring.

#### RELATIONSHIP TO THE WEATHER.

The epidemic character of leaf curl has been frequently noticed and attempts made to connect the sporadic character of the disease with some climatic factor. No very definite statements can be made further than the suggestion that the phenomenon referred to can perhaps best be explained as due to the influence of certain climatic factors upon the spores either at the time (a) they are being scattered or (b) during germination and infection of the tree.

## TREATMENT.

Leaf curl may be prevented by

(1.) Spraying with Bordeaux just previous to the opening of the buds in the spring.

(2.) Spraying again with weaker Bordeaux as soon as the petals of flowers have fallen; this is to prevent late infection from the ground or neighboring trees.

(3.) Spraying again with weak Bordeaux when the first leaves are full grown or when the spores of the fungus are developing. This is to prevent summer infection and cover places where spores may lodge to pass over the winter.

Where winter spraying against San Jose Scale with the lime-sulfur-salt wash is conducted this treatment may suffice of itself to hold the curl in check.

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## ROSETTE.

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### HISTORY AND DISTRIBUTION.

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The rosette is known from a few stations in the West, but is principally known from Georgia and a part of South Carolina. It is found in peaches and almonds and perhaps also in plums. It seems not to have attracted much attention in Georgia until about ten years ago, but is now known to be present in many counties in budded and seedling orchards and also in seedlings growing in out of the way places.

### SYMPTOMS.

The rosette is in some respects closely related to the yellows. It may attack only parts of the tree at first, but may appear suddenly in the spring attacking nearly the whole tree at once. In such cases all the leaf buds grow out into compact tufts of leaves or rosettes, whence the name. Fig. 10 on Plate IV shows some of these characteristic rosettes. If a tree is attacked all over it will die the following autumn, but if only one or more branches are first attacked then only the diseased branches will die after a period of about six months. The leaves in these rosettes are generally of a peculiar yellowish color. The lower leaves in the rosette are frequently much larger than the normal

leaves and have inrolled margins and are stiffer than the usual leaves of the peach. These outer larger leaves turn yellow and fall early in the season while the inner leaves are still green. If a tree is attacked in all parts it bears no fruit, but otherwise the fruit born will generally be apt to shrivel up while still green and fall off or it may ripen naturally.

The disease may be spread through budding or root grafting as has been demonstrated by many experiments. However, it is known that mere contact of diseased with healthy tissue is not sufficient to introduce the disease, but there must be a real union of the two tissues.

#### AETIOLOGY.

Like the yellows the exact cause of rosette is yet unknown.

#### TREATMENT.

All trees which show the rosette in the spring should be at once dug up and burned. If any of the diseased leaves have fallen these should be gathered also and burned as they may serve as sources of infection.

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## YELLOW.

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### HISTORY AND DISTRIBUTION.

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This distinctly American disease is known to affect, in addition to the peach, the almond, nectarine, apricot and plum. It seems to be widely distributed in the United States.

### SYMPTOMS.

"Prematurely ripe, red-spotted fruits, and premature unfolding of the leaf buds into slender, pale shoots, or into branched, broom-like growths, are the most characteristic symptoms of yellows." The reddish spots in the fruit extend from the skin to the stone and their presence is one of the best tests for the disease.

During the first season that the disease is present in any given tree it may confine its attacks to one or a few only of the branches, but in later years other symptoms may appear and these are principally the premature opening of the winter buds. This is most plainly seen in the fall after the tree has lost all its leaves. The shoots may at this time be produced from these prematurely opened buds and are then very conspicuous. Very feeble shoots may also appear on the larger branches of the tree and these also are rather conspicuous on account of their broom-like appearance. In the later stages of the disease or when the disease has been present in a tree for several years the yellowing of the leaves may become apparent and this condition has given rise to the common name, but this is not the most conspicuous symptom and has led many to confuse the disease with leaf curl and other diseases.

### AETIOLOGY.

The exact cause of the disease is not yet known, though it is generally looked upon as a so-called "physiological dis-

ease." As to its spread and its infectious nature we are certain. It may be present in a dormant condition in buds employed in the nursery for budding and the disease is often introduced into a new region in just this manner.

The disease is also known to be spread from living and dead trees affected with the disease to healthy trees in the same orchard.

Soil and climatic conditions certainly cannot be charged with the cause of a disease which possesses such an infectious or contagious nature and there is no good evidence to show that the disease is caused by bacteria or other vegetable organisms.

#### TREATMENT.

The only line of treatment that promises to control the disease is to dig and burn the roots and entire tree as soon as it shows certain symptoms of this disease. Spraying is of no value and special fertilization of the soil seems to be of no value in its control. "Pits" or seeds from diseased trees should never be employed in a nursery or elsewhere.

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## PEAR.

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### BLIGHT.

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#### HISTORY AND DISTRIBUTION.

Pear blight, called also twig blight, and fire blight, is a contagious bacterial disease of pear, apple, quince and other pomaceous fruit trees. It is of very wide distribution and may be found practically throughout the United States east of the Mississippi river. It has been ascribed to the most



various causes, but the complete demonstration of its bacterial nature was made by Dr. Burrill, of Illinois, in 1879.

#### SYMPTOMS.

This disease attacks the flowers, young fruits and the young twigs and shoots, frequently working its way down through the bark to the larger limbs or even to the trunk itself. The disease has its most prominent symptom in the blackish discoloration of the leaves on the attacked twigs, but the bacteria do not as a rule find their way into the leaves except into the petiole and the larger veins. This discoloration of the leaves occurs in a week or more after the death of the branch on which they are found. (See Fig. 15 on Plate VI.)

There is much variation in the manner the attacked plant behaves or rather in the way the disease works. In some cases the affected twig is simply girdled and in that case the damage is not so great as when the whole twig or branch is killed. The very sudden death and rapid discoloration of the leaves has led many to suppose that the disease spreads in the tree more rapidly than it actually does. As a matter of fact the disease does not spread more than 2 to 10 inches per day in the twigs.

In the spring the blight first makes its appearance in the blossoms causing there the so-called "blossom blight." The most rapid distribution of the disease in the orchard takes place while the tree is in bloom. It is now known that the principle agency in this work is the various bees that visit these flowers for the nectar there found. In this nectar the bacteria causing the blight find a most suitable situation for rapid development. Bees going from flowers whose nectar contain even a few of these bacteria to healthy flowers on the same or other trees are very apt to carry some of the germs and thus rapidly spread the infection.

The disease also gains entrance to the plant through the tips of young shoots or twigs. This form of blight is often referred to as twig blight. In the case of nursery stock

not in flower the disease is more often carried about in this manner.

#### AETIOLOGY.

Pear blight is now known to be due to *Bacillus amylovorus*, one of the bacteria. This discovery was made in 1879 by Dr. T. J. Burrill. By means of the usual inoculation experiments this has been demonstrated beyond a shadow of doubt. There can never be any blight in the absence of this species of bacteria, no matter how very favorable soil and climatic conditions may be.

It was once supposed that the germ might live over winter in the ground, but that is now known to be false. As a rule the blight ceases at the close of the growing season, but in some cases, particularly where new infection has taken place late in the season, the germs may live over winter in the twigs and slowly push out into the healthy bark during the winter. The blighted twigs hold their moisture longer than healthy twigs and this is naturally very favorable to the germ and besides it is known that the germ may be exposed to a freezing temperature without injury.

In the spring the rapid accumulation of sap in the twigs sets up a flow of gum from the twigs in many cases and if the germs are alive in any of the twigs they are naturally carried out by this gum flow. Bees and other insects are attracted to this gum and by this means the germs are carried to flowers at which point they rapidly multiply in the nectar and enter the twig.

#### INFLUENCE OF ENVIRONMENT UPON THE DISEASE.

The pear blight makes best headway during warm moist weather and is more or less retarded by cold, dry and sunny weather. The germ is very sensitive to dryness and in the old, dead and dry twigs the germs will all be found to be dead.

## TREATMENT.

## Disease resistant sorts—

Such sorts as the Keiffer and Duchess resist the blight more than the Bartlett and some others and in general the apple is much less injured by the disease than are the pear and quince. There seems to be no need of attempting to breed special resistant sorts when we consider the positive remedial measures mention below.

## Cultivation and soil fertility—

In general we may state that a well cultivated, highly fertilized and rapidly growing tree is most apt to be attacked by the blight. The use of too much barnyard manure is particularly dangerous if the soil is already rich in nitrogenous matter. In some cases it may be well to avoid too excessive cultivation. In general any measure that will tend to check the too rapid growth of the tree will tend at the same time to protect the tree against the blight. Heavy pruning in the winter time, since it promotes rapid formation of much new wood in the spring, may also be avoided at times with good results.

## Treatment—

The absolute destruction of every blight germ should be aimed at and may be secured by the pruning away and destruction of each and every blighted twig as soon as detected. These may be removed during the growing season, but it is best to do this very thoroughly at the close of the growing season, but before the leaves have fallen. The blighted leaves will then serve as a guide. Most careful inspection of the trees must be made during the winter and again early in the spring before new growth starts to make sure that no cases of living blight are allowed to remain in the orchard. This is important since these cases of blight that are allowed to live over winter are the only starting points for new infection in the following spring.

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\*This Bulletin bears on the outside the date, April, 1903, but within contains the statement, "Issued June 30, 1903."

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LEAF BLIGHT.

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HISTORY AND DISTRIBUTION.

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This disease has long been known to horticulturists as the "leaf blight" or "scald" of pear and as the "cracking" of the fruit. It occurs practically wherever the pear is cultivated. It was mentioned in this country early in the sixties.

SYMPTOMS.

The prominent symptoms are the premature discoloration of the leaves and their falling off together with the frequent cracking of the fruit. This leaf fall may be sudden or more gradual, extending in the latter case throughout the growing season. Often the leaf fall is accompanied with a second blossoming—both together making a rather severe drain upon the food supplies of the tree.

Small reddish spots are first seen upon the leaves; these spots as they increase in size take upon themselves a more definite circular shape. At maturity the spots are provided with a white to reddish brown center and a darker raised border. The spots may unite with each other and thus the whole leaf may become affected. The spots may come to be seated upon a reddish brown discolored leaf or the leaf may turn yellow. In any case the leaves fall from the tree.

In many cases there is also a so-called "cracking of the pear" produced by the same fungus. Small reddish spots appear upon the fruit and these spots may rapidly increase in number and finally coalesce with one another to give the fruit a very much blotched appearance that will greatly reduce its market value. At the same time the growth of the spots may be accompanied by a cracking of the fruit and of course this cracking may make an entrance for the spores of the rot fungi that may cause much damage. The same fungus often attacks the young twig of the pear. The spots upon the green bark of these twigs are somewhat elongated, sunken and of a black color.

In each of the spots referred to above on either the leaves, fruits or twigs one may see one or more blackish spots just beneath the surface. These spots are the spore producing bodies of the fungus.

The petioles and leaf scales are also frequently attacked.

#### AETIOLOGY.

This disease is produced by the fungus *Entomosporium maculatum*.

#### TREATMENT.

Fallen leaves should be gathered together and burned.

The disease may be controlled by spraying with Bordeaux mixture, as follows:

- (1.) When leaves are half grown.

(2.) Three subsequent sprayings at intervals of two weeks.

The sprayings after the second should be made with ammoniacal copper carbonat to avoid the "russetting" injury to the fruit often produced by the Bordeaux mixture.

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#### SCAB.

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#### HISTORY AND DISTRIBUTION.

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The scab of pear is, like the similar disease of apple, very

widespread and well known. It is known from practically every region where pears are grown.

#### SYMPTOMS.

The symptoms are practically the same as for the apple scab. (See page 97.)

#### AETIOLOGY.

This disease is due to the fungus called *Fusicladium pirinum*.

#### TREATMENT.

The diseased leaves should be plowed under or else gathered together and burned during the fall.

Two sprayings with Bordeaux mixture of the 1-10 formula should be made while the pear leaves are opening. Considerable good in controlling pear scab will result from a spraying with the lime-sulphur-salt mixture as late in the winter as possible.

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 fig. 1—9.

## PLUM

### CANKER.

#### HISTORY AND DISTRIBUTION.

This disease is one of the most serious plum diseases we have to contend with in this State. Its distribution is somewhat uncertain.

#### SYMPTOMS.

The real canker may be preceded by a gummosis. (See Gummosis under Cherry on page 106.) And this gummosis may be due to one of several causes. But when through gummosis or any other cause wounds of plum trees remain for a long time unhealed a canker may form on the twig.

It is probable that aside from wounding the most frequent source of the trouble is to be found in the attacks of the brown rot fungus. (*Sclerotinia fructigena*.) This fungus, as has been explained, works in the tissues of the twigs, particularly the fruiting spores, and finally may kill such parts. Then gummosis sets in to be followed soon by the canker. The canker may also follow severe attacks of plum pockets.

The Japan plums, being very subject to brown rot, and having soft coarse grained wood, are very apt to succumb to this canker.



### TREATMENT.

The only treatment to be recommended consists in a thorough spraying to prevent the brown rot and plum pockets; and then the removal and burning of the cankered limbs.

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### PLUM POCKETS.

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### HISTORY AND DISTRIBUTION.

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This disease on account of its very characteristic and striking symptoms has long been known to horticulturists and others. It is very widely distributed throughout the United States and has frequently been forwarded to me from various parts of this State.

### SYMPTOMS.

The vegetative portion or mycelium lives over winter in the younger twigs and grows out into the developing ovaries in the spring. All or most all of the parts of the ovary are affected and the action of the fungus is to greatly stimulate the tissues of the ovary so that a very rapid growth takes place. The result is a much swollen, somewhat irregular and spongy body of light yellowish or white color (Fig. 17 on Plate VII.) No stone is developed in this "plum-pocket" but the center is hollow or frequently traversed by loose threads of torn tissue.

The leaf buds and young twigs may also become modified by the action of this fungus to form very irregular spongy swollen objects. In this case the resulting hypertrophy varies with the stage at which the fungus begins its work. If the leaves are not far developed when attacked their normal form may never be attained, but the hypertrophy may affect only a portion of the leaf if its attack is made upon the leaf when partly grown.

#### AETIOLOGY.

This disease is produced by the fungus *Exoascus pruni*—a species somewhat closely related to the one causing the leaf curl of the peach.

#### TREATMENT.

No special spraying treatment can be recommended, though the use of Bordeaux mixture would no doubt reduce the chance of infection. Diseased fruits, buds, leaves and twigs should be removed and burned.

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#### FUNGICIDES.

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Spraying is now looked upon by progressive and successful fruit growers as a necessary operation to be per-

formed if a full crop of fruit of a good quality is desired. In the case of a large and increasing number of diseases spraying has been demonstrated on a large scale to be of immense value. The financial gain from intelligent spraying depends solely upon the number of trees and the diseases prevalent in your orchards.

*Spraying is plant insurance and, like life insurance, should be attended to before the disease has gained a foothold in the orchard. All trees should be sprayed every year whether the diseases usually present make their appearance or not.*

A large number of formulas have been proposed by various investigators for special purposes. We give below directions in some detail for the preparation of the fungicides now most widely employed in connection with diseases mentioned in this Bulletin.

#### BORDEAUX MIXTURE.

Bordeaux mixture consists of two essential ingredients, freshly slaked lime and copper sulfat, dissolved in water. The fungicidal action is entirely dependent upon the copper sulfat. The lime is added for the following reasons:

- (1.) To prevent injury to the foliage.
- (2.) To render the mixture more adhesive.
- (3.) To render the mixture more readily seen after being applied.

#### STANDARD FORMULA FOR "1-10" BORDEAUX.

We give here the formula of the common "1-10" Bordeaux mixture—so-called because it contains 1 pound of copper sulfat to 10 gallons of water.

Copper sulfat—5 pounds.

Quick lime (not slaked)—3 1-2 to 5 pounds.

Water—50 gallons.

- A. Dissolve the 5 pounds of copper sulfat in hot or cold water in a wooden vessel. Dilute the solution thus secured to 25 gallons.

- B. Slake the lime carefully and thoroughly. Dilute this milk of lime to 25 gallons.
- C. Pour the two solutions thus obtained through strainers, at the same time, into the spray barrel. The mixture in the spray barrel should be stirred while the two solutions are being poured together.
- D. Never attempt to mix the two solutions until they have been diluted as suggested above.

#### SPECIAL DIRECTIONS.

- A. The copper sulfat may best be dissolved in cold water by suspending it in a coarse sack near the top of the water.
- B. In slaking the lime add at first a small amount of water, preferably hot water, and then, as slaking begins, continue to add small amounts of cold water as needed. Never add much water at a time and never allow the lime to become dry.
- C. For the more tender foliage of peaches and plums employ the "1-25" Bordeaux mixture, i. e., one containing 2 pounds of copper sulfat to 50 gallons of water.
- D. In all cases use at least 2 pounds of lime to 3 pounds of copper sulfat.
- E. A small amount of yellow prussiate of potash or potassium ferrocyanid dissolved in about ten times its bulk of water is often used as the so-called "ferrocyanid" test to determine whether or no the Bordeaux is properly made. A few drops of this solution are added to the Bordeaux. If a brown discoloration at once appears not enough lime has been used. Continue to add lime solution and stir until no discoloration appears upon adding a few drops of the ferrocyanid solution.
- F. *The most important precaution is to unite the cold dilute solutions of lime and copper sulfat quickly and then to stir the mixture thoroughly. (See Fig. 22 on Plate IX.)*

### AMMONIACAL SOLUTION OF COPPER CARBONAT.

This mixture, designed for use when the Bordeaux might by adhering to the fruit injure its market value, is made according to the following formula:

Copper Carbonat—6 ounces.

Ammonia—3 pints.

Water—50 gallons.

The copper carbonat is to be dissolved in the ammonia, just as much ammonia being used as is required to dissolve the copper carbonat. This solution is then thoroughly stirred into the water.

### LIME-SULFUR-SALT WASH.

This wash, long used along the Pacific coast to control the San Jose Scale, has recently sprung into favor for the same purpose in the East. We mention it here since its use seems to reduce various plant diseases, particularly apple scab and peach leaf curl. It is in a sense therefore both an insecticide and a fungicide. We give but one of the several formulas suggested:

Stone or lump lime—15 lbs.

"Flowers of sulfur"—15 lbs.

Salt—15 lbs.

Water—50 gallons.

"Place the lime in a kettle, or in a vat if steam is used, and slake it with hot water so that it forms an even white paste. Now add enough water to reduce the lime paste to a thin whitewash. The sulphur and salt are then added and should be thoroughly stirred in. If the mixture is not already boiling, bring it to this point and allow it to boil for one hour."

Stir the mixture frequently and at the end of the hour dilute the resulting mixture with hot water to make the required amount. Apply the wash, while hot, with any good nozzle to the trees.

This mixture is very caustic and must be applied to none

but dormant trees and should not be allowed to come into contact with the hands or face.

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## SPRAYING MACHINERY.

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The type of spraying outfit to be employed and its size depends upon the size of the orchard in which it is to be employed. We can only briefly consider the matter here and refer to the two essential parts of any spray outfit: (1) the nozzle and (2) the pump and its accessory parts.

No nozzle of the multitude of forms upon the market is superior to those constructed on the principle of the Vermorel nozzle. These nozzles will give fairly good results even when the pump gives a very low pressure, though best results are secured with pressures of 100 pounds or higher. The "mistry" nozzle (Fig. 24 on Plate IX) made by the Goulds Mfg. Co., is of the Vermorel type and throws a finer spray with low pressures than do the Vermorel nozzles.

A good spray pump should have all working parts exposed to the spraying mixtures made of brass or some sort of bronze. And in addition neither rubber nor leather valves should be used. Assuming these two characteristics to be present the spray outfit is to be selected to fit the local conditions, particularly the number of trees to be sprayed. Fig. 23 on Plate IX, shows a well known type of pump to be attached to a barrel.

For further information on the subject of spraying outfits, consult the references in the Bibliography following and the catalogues to be secured from the following firms:—well known as makers of spray outfits:

Deming Co., Salem, Ohio.

Field Force Pump Co., Elmira, N. Y.

Goulds Mfg. Co., Seneca Falls, N. Y.

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## EXPLANATION OF PLATES.

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### PLATE I.

- Fig. 1. Bitter rot of apples showing both isolated and confluent diseased areas and the concentric circles formed by the fruiting bodies of the fungus causing the disease. (From Bull. 44, Bureau of Plant Industry, U. S. Dept. Agr.)
- Fig. 2. Limb cankers produced by the fungus causing the bitter rot. (From Bull. 44, Bureau of Plant Industry, U. S. Dept. Agr.)

### PLATE II.

- Fig. 3. Twig of the red cedar showing one of the galls called "cedar-apples." This gall is produced by one stage of the same fungus that causes the rust of apple leaves. (Original.)

- Fig. 4.** The lower surface of an apple leaf showing the peculiar elongated horn-like fruiting bodies of the fungus causing the apple leaf rust. (From Rept. U. S. Dept. Agr. for 1888.)
- Fig. 5.** Fly speck and sooty blotch of the apple. (From Bull. 79, Ohio Exp. Stat.)
- Fig. 6.** The upper pile of apples is from the sprayed tree, the lower pile from the unsprayed tree—both together show the advantage in spraying against the apple black rot. (From Bull. 59, Ky. Exp. Stat.)

### PLATE III.

- Fig. 7.** Brown rot of peaches. (From Bull. 50, Ga. Exp. Stat.)
- Fig. 8.** "Mummy" peaches, killed by the brown rot diseases, adhering to the tree and thus constituting a very fruitful source of new infection. (From Bull. 10, Ga. Exp. Stat.)

### PLATE IV.

- Fig. 9.** Leaf curl of peach. (From Bull. 20, Div. Veg. Phys. & Path. U. S. Dept. Agr.)
- Fig. 10.** Rosette of peach. (From Journ. Mycol. Vol. 6.)

### PLATE V.

- Fig. 11.** Longitudinal section of a root affected with crown gall. (From Bull. 33, Arizona Exp. Stat.)
- Fig. 12.** Crown gall; the upper left hand figure shows gall on Lombardy poplar, the upper right hand figure on pear and the two lower figures on peach. (From Journ. Mycol. Vol. 7.)
- Fig. 13.** Crown gall on apple; this gall appeared at the point where the graft was inserted shown at "A" in the figure. (From Bull. 93, Ky. Exp. Stat.)
- Fig. 14.** Crown gall showing the growth of new gall tissue after the removal of the old gall. (From Bull. 33, Arizona Exp. Stat.)

## PLATE VI.

- Fig. 15. Pear blight. (Original.)
- Fig. 16. Hairy root of peach. (From Rept. Geneva N. Y. Exp. Stat. for 1900.)

## PLATE VII.

- Fig. 17. Plum pockets. (From Rept. U. S. Dept. Agr. 1888.)
- Fig. 18. Black knot on plum. (From Prof. Farlow's paper in Bull. Bussey Institution, 1876.)
- Fig. 19. Apple canker. (From Bull. 163, N. Y. Geneva Exp. Stat.)

## PLATE VIII.

- Fig. 20. "Shot-hole" affect produced on Japan plum leaves by improper spraying. (From Bull. 164, N. Y. Cornell Exp. Stat.)
- Fig. 21. Cherry leaf-spot disease. (From Report N. Y. Geneva Exp. Stat., 1896.)

## PLATE IX.

- Fig. 22. Jars showing, after one hour's standing, the amount of settling of the precipitate in Bordeaux mixture made in the following ways. The lower light colored part in each figure is the precipitate:
  - A. Dilute lime poured into dilute sulfat slowly.
  - B. Dilute sulfat poured into dilute lime slowly.
  - C. Made as in E, but using hot lime milk.
  - D. Made as in E, but less thoroughly stirred.
  - E. Properly made from dilute solutions, quickly united and thoroughly stirred.
  - F. Made as in E, but with concentrated solutions.
  - G. Properly made mixture, one day old.
  - H. Old Bordeaux mixture, two weeks old.
  - I. "Bordeaux Powder" mixed with water.
- Fig. 23. One example of the barrel-type of spraying apparatus. (From Bull. 243, N. Y. Geneva Exp. Stat.)
- Fig. 24. "Mistry" spray nozzle. (Cut loaned by the Goulds Mfg. Co., Seneca Falls, N. Y.)

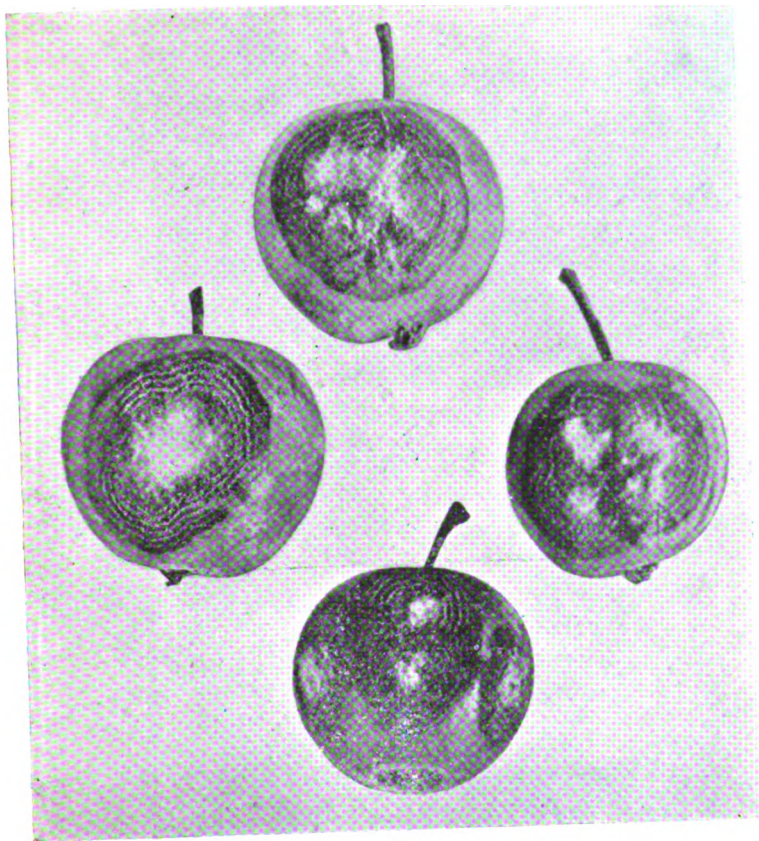


Fig. 1.







Fig 3.

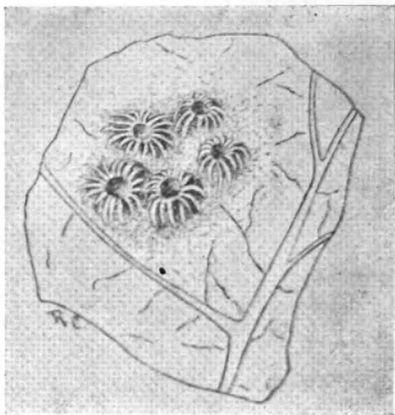


Fig. 4.

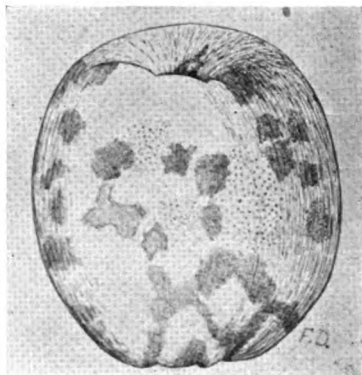
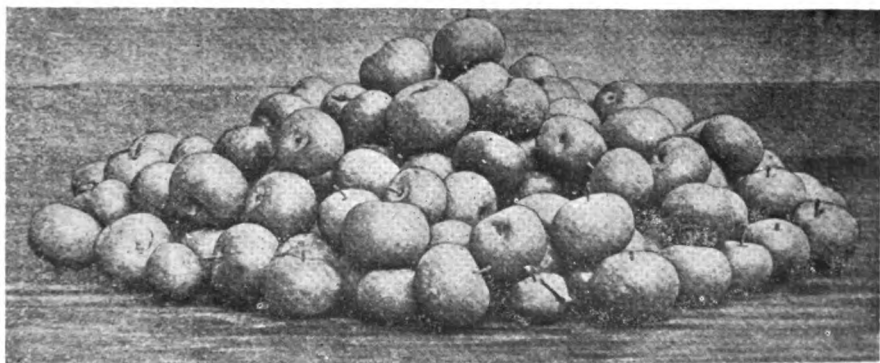


Fig 5.





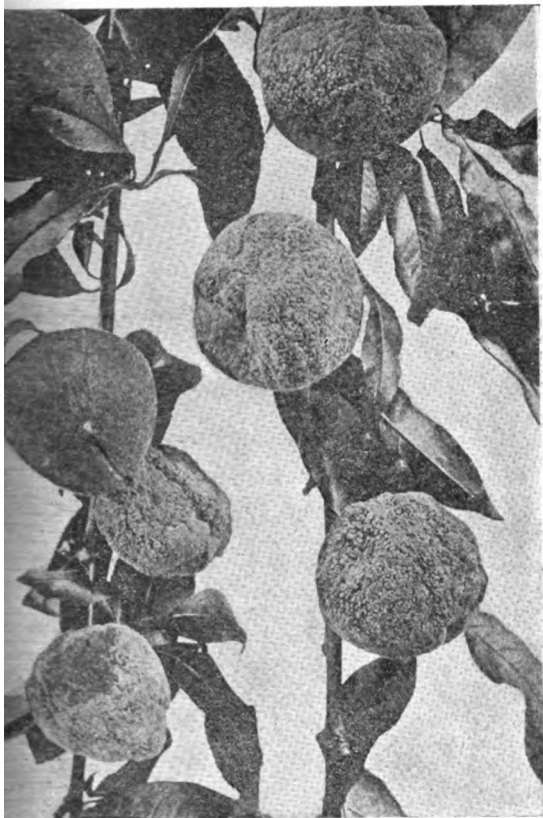


Fig. 7.







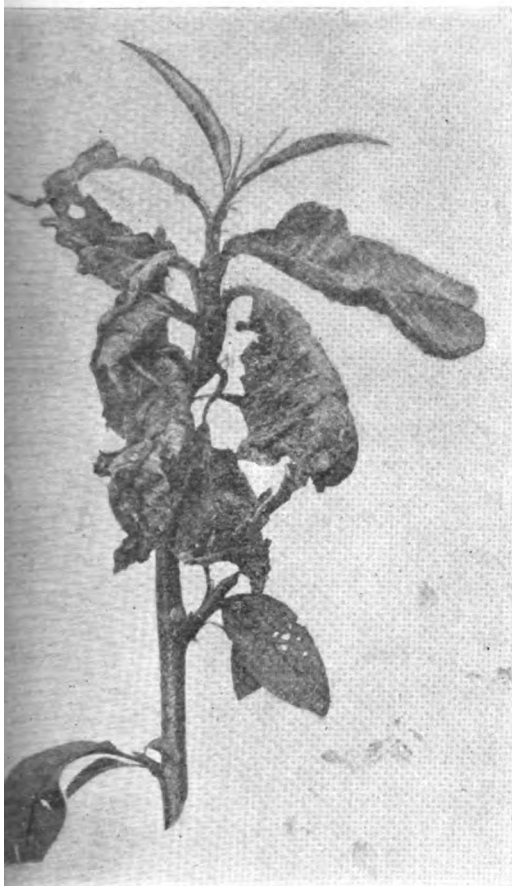


Fig. 9.





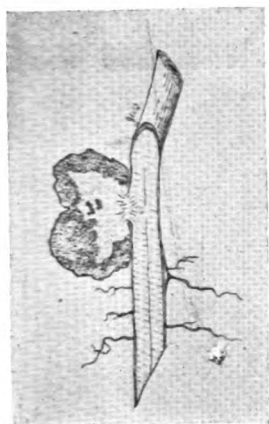


Fig 11.

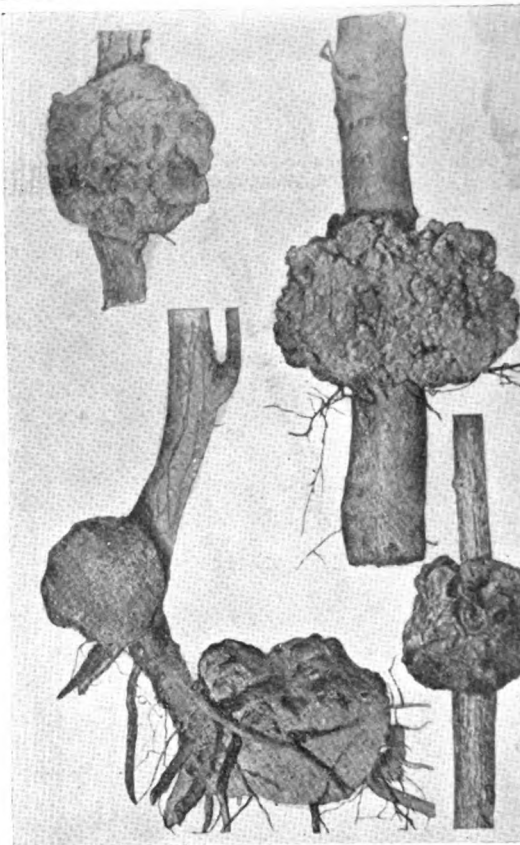


Fig 12.







Fig. 15.

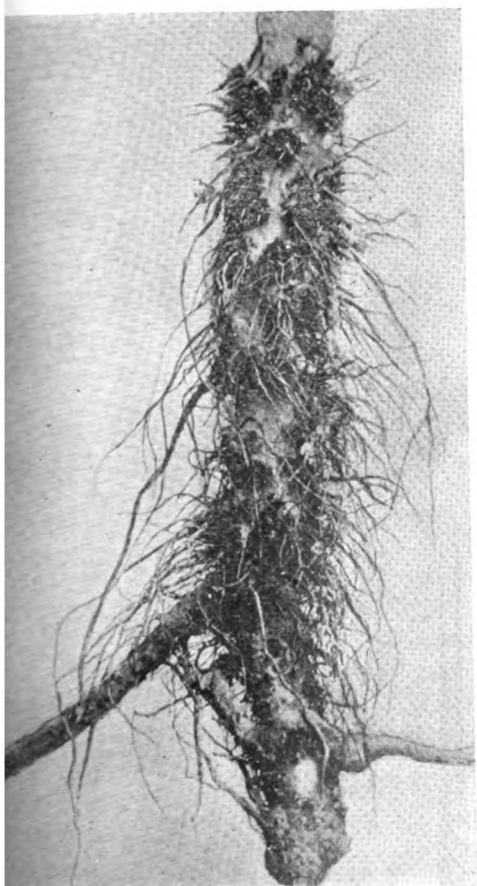






Fig. 17.

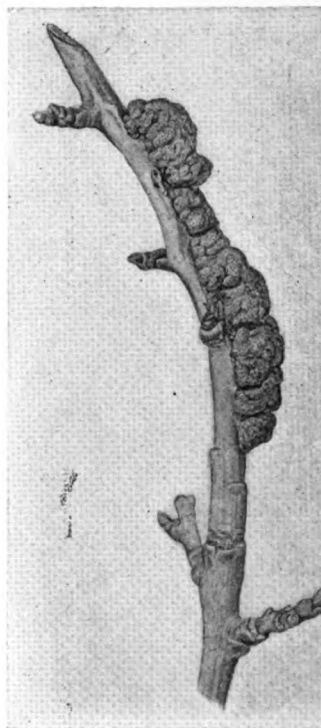


Fig. 18.

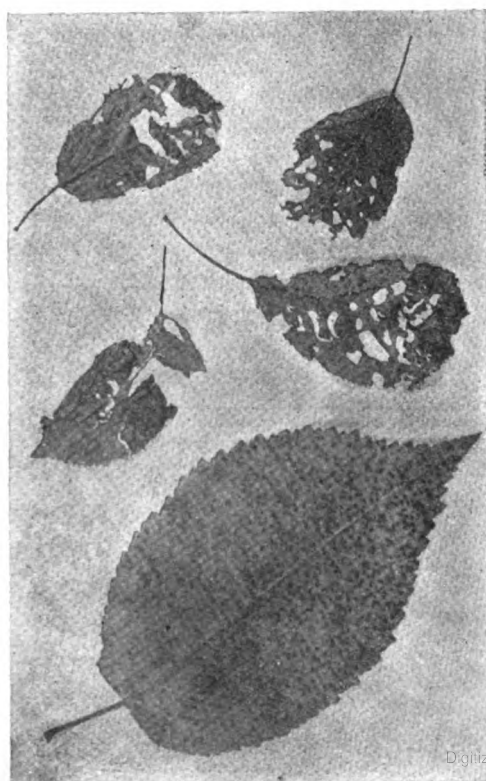








Fig. 20.





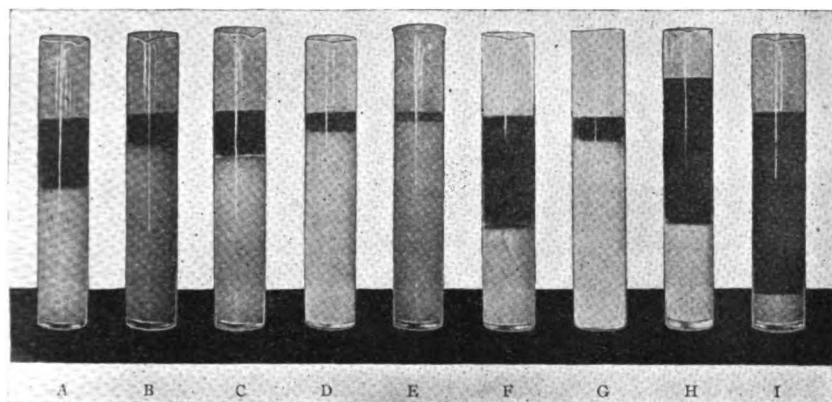


Fig. 22.

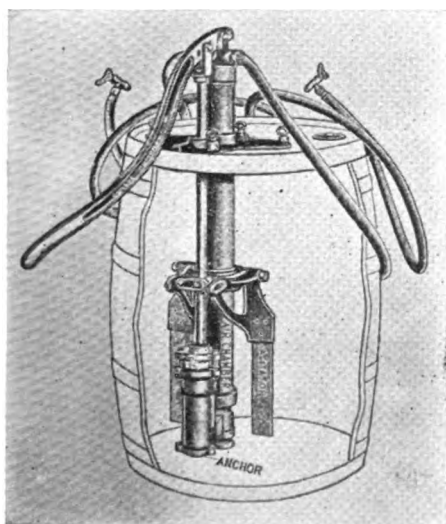


Fig. 23.

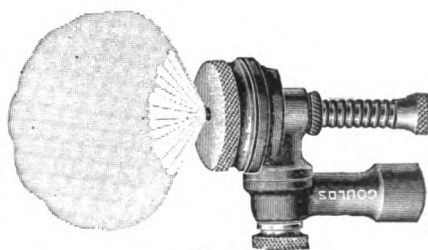


Fig. 24.



**BULLETIN NO. 133.**

**DECEMBER, 1905.**

**ALABAMA**  
**Agricultural Experiment Station**  
**OF THE**  
**Alabama Polytechnic Institute,**  
**AUBURN.**

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**The Manufacture of Cane Syrup.**

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**By**

**B. B. ROSS**

**Chemist.**

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

## THE MANUFACTURE OF CANE SYRUP.

By B. B. Ross.

The Chemical Department of the Experiment Station has, within the past few years, issued two bulletins of the regular series, and at least one press bulletin, upon the subject of syrup making, but owing to the extent to which this industry has progressed in this State and on account of the numerous inquiries which have reached this office with regard to methods of clarification and of manufacture of syrups, it is deemed advisable to issue the present bulletin, which is designed to furnish fuller and more detailed information upon his subject than has been supplied by previous publications of this department.

The official reports of the twelfth census of the United States revealed the fact that sugar cane was grown and cane-syrup manufactured in forty-four out of the sixty-six counties of the State and while these statistics indicate a wider distribution of this crop throughout the State than has been generally supposed, the area of profitable and satisfactory cultivation of sugar cane would have to be restricted to a considerably smaller number of counties, although it can be produced with greater or less success throughout the whole of Southern and Middle Alabama. In many of these counties patches of no larger area than from one-half to one acre are to be found in cultivation, while in the Southernmost tier of counties of the state some tracts of from ten to fifty acres are being devoted to cane growing for syrup production.

As regards the date of the introduction of sugar cane culture in Alabama, no definite or authentic information can be secured and there is even some difference of opinion as to how and where this important saccharine plant reached this continent. Dr. Stubbs, formerly Director of the Louisiana Sugar Experiment Station, who has investigated quite



carefully and critically the history of the sugar cane, is inclined to the opinion that Cochin China or Bengal was its original habitat, the cane plant being introduced successively into Arabia, Nubia, Ethiopia and Egypt, while, after the crusades, it found its way to Syria, Cyprus and Sicily. Some four centuries ago it was introduced into Madeira and the Canary Islands, and, until the beginning of the Nineteenth century, practically the whole of the sugar consumption of Europe was obtained from these islands.

Soon after the discovery of San Domingo, sugar cane culture was inaugurated in that island, and later, sugar cane was carried from there to South and Central America, to Mexico, to other islands of the West Indies, and finally in 1751 to Louisiana. Although attempts were made at that early period to grow cane and produce sugar in the vicinity of New Orleans, it appears that the first efforts were entirely unsuccessful, and it was not until about 1794 that Etienne de Bore, operating at a plantation and sugar house almost on the site of Audubon Park in that city, succeeded in demonstrating the practicability of the production of cane sugar upon a commercial scale. This was virtually the beginning of the cane sugar industry in Louisiana, and the successful termination of the experiments of de Bore marked an important epoch in the development of the industrial and agricultural activity of that rich commonwealth.

Soon after the introduction of the sugar cane plant into Louisiana, it is claimed that cane culture was commenced upon a small scale on the East Florida coast and later along the Georgia coast south of Savannah, sugar-making upon a not inconsiderable scale for that period being carried on in the latter state during the early part of the last century. As to whether sugar cane was brought from Louisiana to this state or carried west to Alabama from the Georgia coast, is a question whose solution I have been unable to accomplish, and it is even possible that it might have been introduced direct from some of the West Indian islands.

Suffice it to say, sugar cane culture has been carried on in Southern and Middle Alabama upon a small scale at least almost from the date of the admission of the state into the Union, and while this cane has been grown chiefly for use in the production of syrup, nevertheless, in years gone by, crude and low grade sugar was produced in small quantities upon many plantations by processes still more crude.

As is well known to those residing in Middle and Southern Alabama, nearly all of the villages and towns of those sections of the state are supplied with home made cane syrup during the fall and winter months, and there has been a steady increase in the production of domestic syrup for a number of years past, although during the remainder of the year the local product does not meet the requirements of the local consumption.

The cane syrup production of this State in the last census year, according to the figures given in the twelfth census reports, was much larger than many of our own people would imagine, aggregating a total of 2,672,438 gallons of syrup upon 32,871 acres, although no allowance was made for the acreage of cane reserved for planting. The value assigned this product was \$1,003,922, and though no information is given with regard to the marketing of this syrup there is no little doubt but that domestic consumption absorbed practically the whole output at that time.

The writer has called attention in a number of papers to the fact that at certain seasons of the year even in our local markets, it is well nigh impossible to secure pure cane syrups and the demand is largely supplied by syrup from outside markets.

These imported syrups are often adulterated with corn glucose, or else are the product of reboiling syrups and molasses which have undergone partial fermentation, while in still other cases it has been found that the syrups consist in part of low grade or dark colored molasses or syrups which have been bleached or brightened by treatment with

such chemical agents as bi-sulphite of soda and pulverized zinc.

It is gratifying to note, however, that within the past two or three years there has been a marked increase in the production and consumption of the domestic article in this State, and already some little attention is being given to securing outside markets for a portion of the yearly output of cane syrup. There has also been a noteworthy increase in the number of syrup producers, and some of these newest accessions to the ranks of producers are among the most progressive in the employment of rational and improved methods of cultivation and fertilization, as well as in the utilization of advanced and intelligent methods of manufacture.

In some of the border counties of South Alabama where a few years since cane patches of only from one to five acres were to be found, there can now be seen tracts of from twenty-five to fifty acres in cane, some of which vies in luxuriance and rankness of growth with the cane grown on the rich alluvial lands of Louisiana, while the sugar content is as a rule well in excess of that of the average Louisiana product.

In a previous bulletin the writer stated that as a result of observations and investigations made by him during a residence of several years in the sugar regions of Louisiana the conclusion was reached that the lighter and more easily drained uplands in the lower Mississippi valley yielded from season to season a cane much richer in sugar and total solid matters than the rich alluvial lands of the valley, although a much heavier tonnage was produced on the latter.

The results of experiments and investigations extending throughout a still longer period in this state have shown that the cane grown on the light loamy and sandy lands in the Southern part of this state exhibits a like superiority over the product of the heavy bottom lands of Louisiana, while a good tonnage can be readily secured where a judic-

ious system of fertilization is resorted to.

Much of the South Alabama cane will show a cane sugar content of 15 per cent. and upwards, while samples containing more than 18 per cent. sucrose have been analyzed in the laboratory at Auburn. The co-efficient of purity of the juices is also almost uniformly high, and with a high content of total solids the yield of syrup per ton of cane is correspondingly large.

The following analysis of three samples of cane selected at random while on a visit to Baldwin county may serve to illustrate the excellence of much of the cane grown in that section of the State.

	Sample No. 1	Sample No. 2	Sample No. 3
<b>Total solids</b> .....	19.3	19.2	19.0
<b>Sucrose</b> .....	17.0	15.1	16.9
<b>Reducing sugars</b> .....	1.31	1.92	1.15
<b>Solids not sugars</b> .....	.99	2.18	.95
<b>Co-efficient of purity</b> .....	88.1	78.7	88.9

When the fact is noted that much of the Louisiana cane does not show a total solid content in the juice of more than 14 per cent. and a cane sugar content frequently not exceeding 12 per cent., the good quality of such canes as the above is rendered more apparent, and as the syrup producing capacity of a cane is practically in direct proportion to the amount of total solids in the juice, the superiority of these canes for syrup making is at once evident.

Notwithstanding the fact that cane of such high sugar content can be produced upon many of the soils of Middle and Southern Alabama, it must be admitted that prior to the last three or four years the syrup industry had made but little progress from year to year and the production of this commodity commercially had not attained very large proportions.

Among the causes and conditions that have so far contributed to the slow progress and growth of the syrup in-

dustry may be mentioned; the employment of crude and unprogressive methods in the manufacture of the syrup from the cane; the production of syrup of poor keeping quality and lacking in uniformity of composition, character and flavor, and, finally, the failure to build up a market for the product, by reason of the uncertainty of its quality and of its variable composition.

In most cases throughout the cane growing region of Alabama, small bottoms are selected for the growing of cane, and, too often, comparatively little attention is paid to fertilization. The crop is grown for several successive years upon the same plot and when the land commences to fall off in productiveness the cane patch is transferred to another bottom which, in turn, becomes the seat of cane growing operations for a number of years, to be later abandoned like its predecessor, when the limit of its producing capacity has been reached.

Fortunately, some of the more intelligent and progressive cane growers in the southern portion of Alabama have demonstrated that the flat, slightly elevated, sandy uplands, with a clay sub-soil can, with proper cultivation and fertilization, be made to produce crops of large tonnage, accompanied by a high sugar content. In that section the best results have been secured by the growing of preparatory green crops, such as cow peas, or velvet beans, which supply the soil with a good proportion of humus forming material and nitrogen, together with no inconsiderable amounts of phosphoric acid and potash brought up from the lower soil. These fertilizing materials furnish nutrition to the cane crop which is to follow, while the humus which has been added to the soil makes the latter more retentive of moisture and better enables it to withstand the droughts which may come sooner or later during the cane growing season. This preliminary treatment of the soil to be devoted to cane culture is followed up by heavy applications of a mixed fertilizer furnishing a moderate supply of phos-

phoric acid and relatively large proportions of nitrogen and potash.

A number of years ago the writer conducted a series of investigations with regard to the composition of the cane plant at different stages of growth, and also made complete analyses of the fully matured plant, including both tops, or blades, and stalks. As a result of these experiments it was ascertained that a crop of twenty tons per acre required for its production 68 pounds of nitrogen, 44 pounds of potash and 30 pounds of phosphoric acid. As the juice from the cane contains only a very small amount of these constituents, it would seem that nearly the whole amount of these materials could be restored to the soil by turning under the bagasse from the cane mill, as well as the leaves stripped from the cane, but in practice the disintegration and the incorporation of the tough and fibrous bagasse in the soil is found to be an extremely difficult problem and in Louisiana this material is used as fuel under the sugar house boilers, while the cane leaves are burned in the field with a view to checking or preventing the ravages of the cane borer.

A glance at the proportions in which these elements occur in the cane will show at once that the cane plant has a strong predilection for nitrogen, and will enable one better to understand the good results secured from the growing of cane upon lands containing abundant natural supplies of this valuable element, or upon which liberal applications of nitrogenous manures have been made.

If the employment of progressive and rational methods is necessary in the cultivation and fertilization of the crop, the use of intelligence and skill in the manufacture of the syrup is doubly essential. Indeed, it is quite surprising that the industry in some portions of this and of the adjacent States has been conducted with any profit, whatever, in view of the crude and uneconomic methods which have obtained to a greater or less extent in the manufacture of

this commodity.

In the first place the extraction of the juice from the cane is often effected most imperfectly, and even where a mill is normally capable of extracting 65 of the 90 per cent. of the juice contained in the cane, its maximum efficiency is seldom realized for the reason that the rolls are not screwed up tightly for fear that the feeding of the mill will be rendered more difficult. On this account, many mills only give an extraction of from 55 to 60 per cent., leaving from 30 to 35 per cent. in the half crushed cane, and, even where the maximum extractive capacity of the average three roller horse mill is attained, there is still a very heavy loss sustained by reason of the unexpressed juice left in the bagasse.

As an illustration of the advantage of the employment of a modern mill of high extractive power, it might be stated that Mr. E. Smith, of Fairhope, Ala., one of the most successful syrup producers in the State, was able to secure as high an extraction as nearly 75 per cent. of juice by the use of a five roller mill purchased by him from George L. Squiers & CO., Buffalo, New York. This mill consisted of two crusher rollers together with a three roller mill of the usual type, and by its employment the yield of juice from the cane was increased more than one fourth. A mill of similar construction is in operation at the plant of the Southern States Lumber Co., at Magnolia Hill plantation, in Baldwin county.

The question of the satisfactory extraction of the juice having been solved, the next problem which presents itself is the proper clarification and evaporation of the juice, and it is in this part of the process that our present or commonly followed methods of procedure have proved most unsatisfactory and unscientific.

The removal of mechanical impurities is often effected by passing the juice through an old burlap bag, while the clarification and evaporation are conducted in a single wooden-frame evaporater, the bottom of which is covered with sheet

copper or galvanized iron, while transverse partitions, supplied with gates or openings, are designed to regulate the flow of juice or of partially cooked syrup from one end of the evaporator to the other.

As a rule, no clarifying agents are employed, and the juice running in at one end of the evaporator is hastily brought to a boil, hurriedly skimmed, and, before full opportunity has been had for the formation or removal of the blanket of impurities, the liquid is pushed rapidly along from compartment to compartment, the impurities in solution and those still left in suspension being rapidly cooked down with the syrup, giving a product dark in color, lacking in delicacy of flavor, and more readily susceptible to fermentation by reason of the presence of an undue proportion of albuminoids and other organic impurities.

As the finished product is commonly allowed to flow out in a slow, continuous stream, with no means of determining its density except by the application of the "rule of thumb," the syrup is greatly lacking in uniformity of density and quality. If, on the one hand, the syrup boiler fails to cook the syrup to a proper density, fermentation is all the more likely to ensue, while if the desirable density is exceeded the product is sure to crystalize, or "sugar," sooner or later.

In addition to all of these defects and disadvantages of the ordinary evaporator, the regulation of the heat is quite a difficult matter. A slow fire will not permit the evaporation to keep pace with the mill, while a too rapid fire may scorch the syrup or cause loss by boiling over, the usual remedy being to rake out some of the fire, or else lift the evaporator off of the furnace, while operations are always resumed after some delay with the possibility or probability of the recurrence of the same trouble after a short interval.

In order to secure the best results in clarification and evaporation, the heat should be easily and quickly controlled, so that evaporation can be accelerated or retarded at



will, or, if necessary, suspended instantaneously. The employment of steam for heating purposes is the only sure means of attaining these ends, and while it may not be practicable to utilize the steam evaporator where only a crop of 200 or 300 gallons of syrup is produced, or where the only use of the boiler employed is in the working up of a small crop of cane, still, steam evaporation can be employed advantageously upon a comparatively small crop upon farms where a boiler and engine can be used to good purpose in other departments of the farm economy. With somewhat larger crops the employment of steam evaporation will be highly desirable without regard to any other possible use of the boiler and engine, as the superiority and uniformity in the quality of the product secured fully justifies the increased initial cost of the steam plant.

As regards the clarification of the juice, a number of different methods of procedure have been adopted in various portions of the cane producing belt of the Southern States and there is naturally some difference of opinion as to the relative merits of the several processes employed.

Where a syrup of higher grade and purity, as well as of a brighter color, is desired, sulphuring and liming of the juice is resorted to, and a much more thorough removal of impurities is affected by this process. With a juice slightly acid in its normal condition the acid reaction is largely increased as a result of the sulphuring process, and a portion of this acidity is overcome by the use of a high grade lime, slaked to a thin paste. Especial care must be taken to avoid the employment of an excess of lime, and the juice should be left distinctly acid to litmus test paper, as inversion, the "bete noir" of the sugar maker, should have no terror to the syrup producer, who should delight in the presence of a large proportion of non-crystallizable sugar in his syrup.

If an excess of lime has been inadvertently added, this excess can be easily removed by the use of a small amount of high grade "acid phosphate" of lime, such as is sold un-

der the trade name of "Clariphos." This latter agent is also employed as a clarifying agent instead of sulphur fumes, and bi-sulphite of lime is also employed to no little extent as a substitute for the sulphur and lime process of clarification.

With the simplest form of sulphuring apparatus ordinarily used in small syrup plants, the juice fresh from the mill is allowed to run slowly through a sulphuring box containing a number of inclined shelves, and, as the juice trickles slowly down from shelf to shelf, it meets with an ascending current of sulphur fumes, which are produced by burning brimstone or roll sulphur in a roughly constructed brick furnace. In this way the juice is at once rendered lighter in color and when heated in the evaporator, after careful liming, the separation of albuminous matters and other impurities is affected more readily and rapidly.

To show the adaptability of even crudely constructed steam evaporators to syrup making on a small scale, experiments have been conducted at the Alabama experiment station at intervals for a number of years with the employment of two small evaporators especially devised for experimental purposes, the smaller of the two being improvised from an ordinary open-fire evaporator already on hand.

The sides of the evaporators were of wood, as usual, and the bottoms were constructed of sheet copper, but no partitions were employed as in the ordinary evaporators. A series of pipes, connected at the end by return bends were placed in the bottom of each evaporator, almost the whole surface of the bottom being thus covered, with the exception of a space about four or five inches in width, which was reserved for the collection of the scums from the boiling juice. This unoccupied space should be on the side of the evaporator opposite to the point at which the steam is admitted, and this side should be slightly lower than the other in order to facilitate the removal of the scums. The piping employed was galvanized iron, from three-fourths to one inch inside

diameter, and valves were provided for the proper regulation of the steam used in the evaporation, while another set of valves enabled the operator to prevent the too rapid escape of waste steam from the coil.

The juice, after sulphuring, is run into the small evaporator or clarifier, milk of lime is added, and the contents of the evaporator brought gradually to a temperature slightly under the boiling point. The scums and impurities come to the surface quite rapidly, the greater portion of them collecting over the space not occupied by the pipes, where they can be easily removed.

The clarifier is somewhat more elevated than the evaporator, and when the juice has been well skimmed it is at once run into the large evaporator, and the steam is immediately turned on. Fresh quantities of the juice are now run into the clarifier, boiled, skimmed and then run into the evaporator, the evaporation of the juice being conducted all the while. Any scums which form in the evaporator can be removed in the usual way, and when the syrup has reached the proper density the steam is shut off and the evaporator is emptied through the usual outlet.

By the substitution of copper coils for the galvanized iron pipe, a very much greater evaporative effect can be secured from the same heating surface and from the same steam pressure—an advantage which will in most cases, outweigh the increased first cost of the evaporating apparatus.

Many of our cane planters and small syrup producers still persist in drawing off the syrup at random, and without reference to its density, notwithstanding the fact that the Beaume hydrometer or saccharometer can be employed to good advantage in determining the point at which the syrup becomes sufficiently dense to be drawn off, and when the spindle immersed in the hot liquid reads 33 to 34 degrees the liquid can then be run out of the evaporator. Farmers in Alabama who have used the Beaume spindle report good

results from its employment, and state that by means of its use no difficulty is experienced in boiling the syrup to a uniform density.

While the flavor of a syrup is a prime consideration in the production of a marketable article, the relative clearness and color of the product is an important factor in determining the price it will bring upon the market, and this fact should not be lost sight of in the clarification and defecation of the juice and syrup, though it also must be borne in mind that the employment of undue proportions of clarifying agents is liable to affect the flavor or taste to an objectionable extent.

Whether the syrup is to be marketed in barrels, cans or bottles, the receptacles in which the product is put up should be well cleaned and thoroughly scalded out or steamed and every precaution taken to exclude ferments from contact with the contents of the vessels.

As is well known, a large part of the cane syrup found on the markets after the first warm weather of the spring sets in is that which has been put up in sealed cans or bottles, and almost invariably in the former. Moreover, a syrup put up hot in a clean vessel, and securely sealed while still hot, may be preserved almost indefinitely without danger of fermentation or of crystallization of sugar.

Samples of syrup in sealed jars or bottles have been preserved at the laboratory of the Alabama Polytechnic Institute for from four to five years without any indication whatever of fermentation or separation of sugar being observed, and analyses of the syrups before and after the completion of the period of the tests, showed no appreciable variations in the composition of the article.

With the exercise of proper care in the clarification and preservation of the genuine cane syrup, the imported, or at least the adulterated article, should soon be excluded from the market, and the consumer can then be assured of the purity and good quality of the goods which he purchases.

Moreover, when it is once known that syrup of good quality and high purity and possessing the fresh taste of the original article, can be obtained in any month in the year, it will be quite easy to build up a market for such goods and the home demand will necessitate an increase in the supply of the home manufactured product, while outside markets will readily take care of the surplus production of an article whose reputation for purity and excellence of quality has become well established.

### EXPERIMENTS IN SYRUP MAKING.

In addition to experiments described in previous bulletins (Nos. 66 and 103,) a large amount of experimental work in methods of syrup making has been done both at the Station and at various syrup plants in the Southern part of the State, facilities for this work having been afforded at Mr. E. Smith's place, near Fairhope, and at the syrup plant of the Southern Industrial Association near Gateswood, Ala., while visits were paid to a number of other plants during the syrup making season.

### EXTRACTION OF JUICE.

A number of extraction tests were made at various steam and horse mills, and it was found that in most cases the proportion of juice extracted by the two roller and three roller mills ranged from 55 to 60 per cent. The highest extraction noted was that secured upon the five roller mill of Mr. E. Smith, to which previous reference was made, and upon some trial runs approximately 75 per cent. extraction of juice was obtained. When the fact is noted that the employment of one of the poorer grades of mills would involve a loss equivalent to five tons of cane per acre upon a crop of twenty tons per acre, the importance of securing a good yield of juice should be readily recognized.

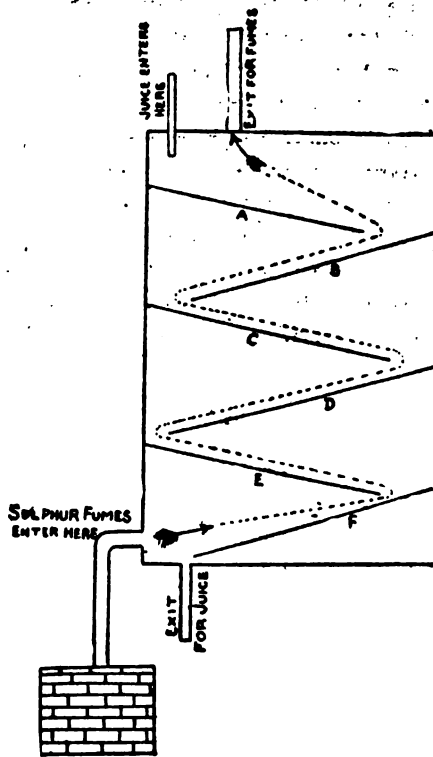
### DEFECATION OR CLARIFICATION OF JUICE.

Allusion has been previously made to the common employ-

ment of burlap strainers for filtering the juice as it comes from the mill, but a strainer of fine sheet metal gauze can be used to much better advantage and can be easily kept clean. This gauze is, of course, chiefly of value in removing particles of trash, small fragments of bagasse, etc.

At some syrup plants in the southern part of the State it was noted that the juice from the mill was conducted through filters of Spanish moss, but so far as the observation of the writer has extended, the utility of this material is solely dependent upon the removal by it of mechanically suspended impurities which are found in the juice.

In bulletin No. 66, a form of sulphuring apparatus which has been much employed in Louisiana was described in detail and illustrated by a cut, this apparatus being constructed substantially as described on a preceeding page in this bulletin. For the information of the readers of the present bulletin this cut is reproduced herewith.



This sulphuring box has been used to good advantage at the Experiment Station and upon some nearby farms, but as some syrup producers have experienced trouble in constructing this particular form of apparatus, it was deemed desirable to devise a somewhat simpler appliance for use in sulphuring juices, and it was soon found that a satisfactory apparatus could be improvised from a large syrup barrel of 50 or 60 gallons capacity.

Several of the upper hoops of the barrel were removed and the head was carefully taken out, in order that a couple of false bottoms might be inserted in the barrel at about one-third and two-thirds of its height, these false bottoms

being held in position by small cleats nailed to the sides of the barrel. A half inch pipe was inserted in the bottom of the barrel to provide for the outflow of juice, while a two inch pipe passing through the side of the barrel about three inches above the bottom was used to convey the sulphur fumes from the small sulphur furnace. A pipe of like dimensions fastened through the top of the barrel was employed as an exit for the fumes, while numerous perforations in the top provided for the inflow of the juice.

Straw was loosely packed between the bottom, the false bottoms and the top of the barrel, before replacing the top, this material being used to cause the juice to break up into a number of fine streams in order that it might expose a larger surface and absorb the sulphur fumes more readily. It was found that instead of perforated false bottoms a framework of small strips could be used to good advantage as a support for the straw.

The sulphur furnace to be employed in connection with the above described sulphuring apparatus can be constructed of a few brick or else a small box of sheet iron can be used. A cone of thick sheet asbestos, with the apex of the cone inserted in the end of the pipe designed to convey the fumes can also be used as a furnace in case a large volume of fumes is not required. Brimstone or roll sulphur is the form of sulphur employed and is burned in a small iron dish or in the inverted top of a tin can, comparatively free access of air being permitted.

It is desirable that the barrel be well filled with fumes before the juice is allowed to run through it and it will be noted that the escaping juice is much brighter in color, while it has been found that in many cases a sufficient absorption of sulphurous acid is effected to admit of the sulphured juice being mixed with an equal volume of the raw juice.

This department has also found that it is possible to employ liquified sulphurous acid in the sulphuring of juice, this product being obtained by condensing sulphur fumes under



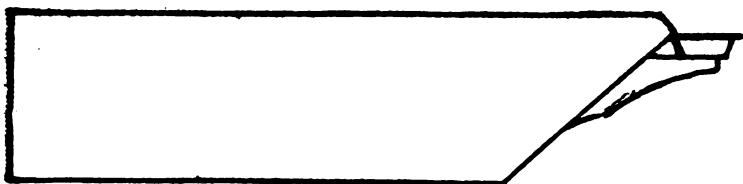
pressure in steel cylinders. A valve is attached to the cylinder and upon opening it slightly a flow of gas takes place, it being possible to conduct this gas through a tube to the bottom of a tall juice vat and as the gas bubbles up through the liquid it will sulphur it quite thoroughly. When purchased in small quantities the liquid sulphurous acid is somewhat expensive for use as a clarifying agent, but if a considerable demand for it were created in a given section, it could no doubt be secured at much lower figures.

If a settling tank is at hand the sulphured juice can be transferred directly thereto and within an hour or two it will be found that a considerable proportion of the impurities of the juice have separated from the main body of the liquid, rendering its subsequent clarification more easy.

The juice is next transferred to the clarifier or small evaporator previously described, and heated up slowly to the boiling point, milk of lime (in the form of a whitewash, free from lumps,) being added until the juice is left only slightly acid as indicated by litmus test paper. The juice is then brought to a brisk boil, so that the blauket or coating of scums rises and shows a number of cracks and seams on its surface, after which the heat is partly cut off and the scums are removed.

A deep form of clarifier is more effective than a shallow one and as before suggested it is desirable that a space unoccupied by the coil of steam pipe be left either at the side or end of the clarifiers and evaporators. It will also be found advantageous to have one end of the clarifier inclined at an angle of about 40 or 45 degrees to the horizontal, the scum trough being attached to the inclined end of the evaporator.

The following cut shows the side elevation of such a clarifier and also the position of the scum trough.



SIDE ELEVATION OF CLARIFIER.

In a clarifier of this character the scums can be pushed along easily by a broad wooden skimmer from one end of the vat to the other, being easily brushed over the inclined end of the clarifier into the scum trough.

Although the use of lime as a clarifying agent is recommended in connection with the employment of sulphur, it is quite possible to secure good results from the use of sulphur, even where lime is omitted, though the sulphur fumes in the absence of lime would give the juice quite a perceptibly acid re-action. Instead of the employment of sulphur fumes for brightening or bleaching the juice, bi-sulphite of lime may be used in the proportion of one quart to 50 gallons of juice, although it does not usually yield quite so bright a syrup as does the juice treated with sulphur fumes. This chemical can be purchased from I. L. Lyons & Co., New Orleans, La., and is prepared by the action of sulphurous acid or sulphur fumes upon milk of lime.

In conjunction with sulphur, or in the entire absence of sulphur, acid phosphate of lime may be used as a clarifying agent and in many cases with most excellent results.

The preparation of acid phosphate used by this department was sold under the trade name of "Clariphos," and was purchased from J. Watts Kearny & Sons., New Orleans. This is simply a strong solution of acid phosphate of lime, which is free from any objectionable impurities and has been prepared especially for use as a clarifying agent in sugar factories.

Prior to the application of this agent the juice must be treated with lime until the original acidity of the juice has

been neutralized and the manufacturers of this preparation even recommended that lime be added in slight excess, or until red litmus test paper changes to a slight blue. At this point the clariphos is added in the proportion of one half gallon to 1000 gallons of juice it being diluted somewhat with water before adding it. Experiments made by the writer indicate that for syrup making it may be used advantageously in as large a proportion as one gallon of clariphos to 1000 gallons of juice.

After addition of this agent, the juice is boiled gently for a moment or two, the heat is turned off and the juice allowed to settle in the clarifier, or else it is run off in a settling tank. The lime which was added previous to the clariphos combines with the free acid of the latter, forming a bulky precipitate which settles rapidly, carrying down with it a large amount of organic impurities and suspended matter and leaving a clear, bright juice, which can easily be drawn off from the sediment. In this connection, it must be noted that the juice should be thoroughly skimmed or brushed after the addition of the lime and before the addition of the "Clariphos," and especial care should be taken to see that the milk of lime is free from lumps or granular particles.

Where agents other than clariphos are employed in clarification and in case considerable suspended matter is still present in the clarified juice, bag filters may be used to some advantage in the removal of much of this suspended matter.

The form of bag filter best adapted to this purpose is a long slender bag of closely woven texture which is supported by an outer bag of coarse netting, the two being suspended from the top of a tall wooden box or chamber which can be closed tightly, so that the interior of the compartment may be well heated by a jet of steam. The juice is allowed to enter the filter through an opening in the top of the chamber, and is drawn off from the bottom into a settling tank or into an evaporator.

By admitting steam to the filtering chamber, the filter and the juice being filtered are both kept hot and the filtration, in consequence, can be effected more rapidly.

This department is under obligations to Mr. West Livan-dais, New Orleans, La., for filter bags kindly donated for use in experiments conducted during the past season.

In case the syrup plant is supplied with a sufficient number of deep clarifiers, the juice may be advantageously evaporated down to semi-syrup in them before being transferred to the final evaporator or an intermediate evaporator may be employed between the clarifiers and the finishing pans. Where this plan is adopted, the semi-syrup is generally allowed to attain a density of from 20 to 25 degrees Beaume, hot, before being transferred to the last evaporator of the series.

Experiments were made during the past season in connection with the employment of sand filters for the removal of suspended matters from the semi-syrup, and where sand of pure quality was employed, some fairly good results were secured.

It was found necessary to wash even the best sand for some little time in order to remove clay and finely divided matter, whose presence rendered the wash water turbid, and when the sand finally permitted the water to pass through clear, it was found that the syrup would also pass through the sand filter comparatively clear and practically free from suspended matter. The sand filter was arranged by employing a tray or shallow box, the bottom of which was constructed of coarse wire gauze, covered by a coarse cloth, upon which a layer of sand of one and a half to two inches thick was placed.

Unless very pure sand, requiring very little washing be used, the employment of sand filters may be found troublesome, however, and the sand will, of course, have to be renewed frequently. Filters of this kind, nevertheless, would serve quite a good purpose in case some special lot of semi-

syrup contained an excessive amount of suspended matter, which previous treatment in the evaporators had failed to remove.

The concentration of the syrup in the final evaporators is continued until the Beaume hydrometer registers about 34 degrees in the hot syrup, and where there is only a thin layer of syrup left in the evaporator, it may be advisable to shut off steam when the instrument registers 33 and one-half degrees, as the hot syrup in contact with the hot pipes which may still contain a little steam, will probably evaporate a little further before it can be drawn off.

For the removal of finely divided suspended particles from the hot syrup, the employment of cotton batting which was suggested and tried last season by Mr. A. F. Cory, at the syrup plant of the Southern Industrial Association, Gatewood, Ala., appears to be quite advantageous and good results were secured both by Mr. Cory and also by the writer in some experiments conducted at Auburn. The kind of cotton batting employed in the syrup filters was the same as that used by the turpentine distillers, one surface of the goods being glazed, while the other surface was rough. The batting was placed upon coarse wire gauze in a shallow box or tray and the syrup was allowed to flow on the filter in such a way as to obviate the possibility of washing a hole through the cotton filter, the liquid being diffused over the whole surface of the material.

Previous allusion has been made to the importance of thoroughly scalding out and steaming the containers in which the syrup is to be put up, and too much care and caution cannot be given to the matter of excluding ferments or bacteria from the packages if an article capable of long preservation is desired.

As regards the arrangement of the settling tanks, vats, clarifiers, evaporators, etc., in the syrup factory, the writer would say that the plan adopted by the Southern States Lumber Co. at their plant at Magnolia Hill plantation in

Baldwin county is a most excellent and convenient one. The juice from the mill is pumped to settling or storage tanks placed on the highest floor in the building, the juice from these tanks being allowed to flow by gravity to the clarifiers or defecators, of which there was one for each storage tank on the next lower floor. The juice or semi-syrup from the defecators was also conducted by gravity to settling tanks on the next lower level, and from there to the large evaporator or finishing pan on a still lower level.

The packing of the syrup was carried out on the ground floor of the plant, the natural slope of the ground having favored the arrangement of the interior of the establishment in the manner described—an arrangement which greatly facilitated the operations of the factory.

#### SMALL CENTRAL SYRUP PLANTS.

Several years since the writer advocated the idea of the operation of small central syrup-making plants in connection with steam gins which are found occurring in such close proximity to each other throughout much of the cane growing territory in this State and practical demonstrations of the feasibility of the plan were made during the past two seasons. Since many of these neighborhood gins suspend operations before any destructive freezes occur, the motive and steam power of these establishments can be utilized to good advantage in making syrup.

During the present season an experiment along this line was made at the place of Mr. J. C. Moore, near Auburn, only a few hours being required to install the clarifiers and evaporators and to make the necessary connections with the boiler, while all the apparatus worked satisfactorily from the beginning of the experiments and quite a good article of syrup was produced.

As before stated, wherever a boiler of sufficient capacity is in use for ginning, milling or other purposes, it is quite a simple matter to install a syrup making outfit, and where

new steam gins are established in cane growing regions, sufficient steam power can be provided to meet the combined requirements of a syrup plant and steam ginnery.

By the adoption of such a plan, small central syrup factories could easily be put in operation throughout a large portion of Southern and Middle Alabama, and the introduction of improved methods of manufacture would quickly follow upon the inauguration of such a system.



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**ALABAMA**

**Agricultural Experiment Station**

**OF THE**

**Alabama Polytechnic Institute,**

**AUBURN.**

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**Corn Culture.**

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**By**

**J. F. DUGGAR,**

**Director and Agriculturist.**

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

# CORN CULTURE

BY J. F. DUGGAR.

## SUMMARY.

During the past ten years 52 varieties of corn have been tested at Auburn, Alabama. Among these the most productive varieties were Mosby, Cocke, Henry Grady and Sanders.

Varieties of the prolific type, "two-eared varieties," afforded larger average yields than did the type in which the number of ears was smaller but the size larger.

Early varieties were relatively unproductive.

Repeated tests of seed corn grown in different latitudes indicated that with certain varieties seed from Virginia and Tennessee proved superior to that from Delaware, Illinois, Alabama and Georgia. It is impossible to determine whether this result was due chiefly to climate or to more careful selection of the seed corn obtained from Virginia and Tennessee. It is generally advisable that seed corn for Alabama be obtained either from this latitude or from some other region south of the Ohio and Potomac rivers.

Many early varieties from northern grown seed afforded a large proportion of unsound corn.

In six tests seed corn from the bottom ear afforded a slightly larger yield than from the top ear and in two tests seed from the top ear gave the larger yield.

Subsoiling did not increase the yield of corn sufficiently to be profitable.

The yield was not materially influenced by the depth of the first cultivation.

Planting corn in water furrows did not increase the yield.

The yield of grain was slightly decreased by pulling fodder, by topping and by cutting and shocking the plant. The average yield of dry fodder or blades was 515 pounds, of

cured tops 473 pounds and of cured stover 1,799 pounds per acre.

The increase in the yield of corn due to the use of velvet bean stubble as a fertilizer was 4.3 bushels per acre. Where the entire growth of velvet beans was plowed under the increase in the first corn crop was 12.3 bushels and the increase in the second corn crop was 4.4 bushels. The increase in the two corn crops was 16.7 bushels greater where the entire growth of velvet beans was plowed under than where only the roots and stubble were plowed under.

The yield of corn was 8.9 bushels per acre greater when cow pea vines were plowed under than when only the stubble was used as fertilizer. The increase from plowing under beggar weed, which grew after the corn was laid by, averaged 5.4 bushels per acre.

When velvet bean vines or cow pea vines were plowed under the addition of acid phosphate profitably increased the yield of corn.

Applying a part of the fertilizer before planting and a part at the second cultivation did not increase the yield as compared with using all of it before planting.

Nitrate of soda afforded a larger increase than did cotton seed meal, cotton seed or barnyard manure.

It is recommended that a fertilizer for corn contain a relatively large proportion of nitrogen.

#### TESTS OF VARIETIES OF CORN IN 1901, 1904 AND 1905.

For ten years in succession tests of varieties of corn have been made on the Experiment Station farm at Auburn under the present management.

Bulletins Number 76, 88 and 111 of this Station, now out of print, give the results of variety tests at Auburn from 1896 to 1900 inclusive. In 1902 an unprecedented drought, from April to August, ruined our variety test, and in 1903 rogues vitiated the results. The results obtained in 1901, 1904 and 1905 are presented in this bulletin.

All of our tests were made on upland soil characteristic of this region, and naturally poor. Only commercial fertilizers were employed, except in 1905, when in addition to commercial fertilizers, barnyard manure, chiefly from cattle, was used at the estimated rate of ten tons per acre.

Planting was done at the usual time or a few days later and the distance between rows was usually 4 feet 8 inches, and between plants about three feet. The distance between plants was the same for all varieties.

Every precaution was taken to secure and maintain a stand, but when this was impaired by bud worms, no correction of yields was attempted.

*Yield of varieties of corn in 1901.*

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Mosby .....	93	<b>35 2</b>	1
Shaw .....	91	<b>31.9</b>	2
Cocke .....	100	<b>31 8</b>	3
Arnold's Cross Bred .....	100	30 1	4
Tennessee White .....	91	29 9	5
Tennessee Yellow .....	100	28 8	6
Red Cob, Tennessee .....	93	27 7	7
Experiment Station Yellow .....	98	27.1	8
Blount .....	95	21 6	9
Jones Pearl .....	99	19 6	10
Hickory King .....	100	18.9	11

*Yield of varieties of corn in 1904.*

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Sanders.....	88	<b>35.5</b>	1
Mosby.....	100	<b>35.5</b>	2
Cocke.....	91	<b>35.5</b>	3
Henry Grady.....	93	32.3	4
Cocke (Ga.).....	96	29.6	5
McMackin's Gourd Seed.....	95	29.6	6
Experiment Station Yellow.....	100	26.8	7
Boone County White (Tenn.).....	87	25.8	8
Boone County White (Ind.).....	92	24.2	9
Boone County Special.....	88	23.5	10
Reid's Yellow Dent.....	92	22.1	11
Riley's Favorite.....	91	19.6	12
No. 77 U. S. Dept. Agr.....	91	19.4	13
Silver Mine (Iowa).....	81	19.1	14
Leaming Yellow.....	94	18.2	15
Snow Flake.....	81	12.9	16

*Yield of varieties of corn in 1905.*

Variety	Per ct. of stand	Yield per acre	Rank in yield
	Per ct.	Bus.	
Henry Grady.....	97	<b>40.6</b>	1
Sanders.....	99	<b>39.4</b>	2
Mosby.....	99	<b>38.9</b>	3
Marlboro.....	97	34.9	4
Local White Cob.....	91	34.3	5
McMackin's Gourd Seed.....	95	33.1	6
No. 77 U. S. Dept. Agr.....	99	32.6	7
Cocke (Tenn.).....	92	30.9	8
Experiment Station Yellow.....	96	30.7	9
Albemarle.....	81	30.3	10
Shaw.....	81	29.7	11
Boone County Special.....	94	29.4	12
Red Cob (Tenn.).....	84	28.9	13
Cocke (Ala. Exp't Sta.).....	92	28.6	14
Hickory King.....	96	28.	15
Boone County White (Tenn.).....	88	26.3	16
Reid's Yellow Dent.....	85	25.7	17
Boone County White (Ind.).....	87	24.6	18
Boone County White (Ill.).....	76	22	19
Silver Mine (Iowa).....	93	22	20
Leaming Yellow.....	94	18.9	21
Riley's Favorite.....	80	17.1	22

*Relative yield of varieties of corn at Auburn, taking the yield of Experiment Station Yellow as 100.*

	1896	1897	1898	1899	1900	1901	1904	1905	Aver age
<i>Tested 8 years</i>									
Mosby.....	91	138	109	92	115	130	132	130	117
Exp't Sta. Yellow.....	100	100	100	100	100	100	100	100	100
<i>Tested 7 years</i>									
Hickory King.....	122	72	73	73	80	70		91	83
<i>Tested 6 years</i>									
Cocke.....		129	87		108	117	118	97	109
Shaw.....		99	117	81	95	118		97	101
Blount.....	132	103	72	83	98	80			95
<i>Tested 5 years</i>									
St. Charles.....	148	90	104	81	96				105
<i>Tested 4 years</i>									
Red Cob (Tenn.).....				82	99	102		96	95
Jones Pearl.....	99	97		93		72			90
Champion White Pearl.....	126	79		74	70				87
<i>Tested 3 years</i>									
Sanders.....					104		132	128	121
Farmer's Pride.....		101	94		96				97
Early Mastodon.....	134	60			91				95
Iowa Silver Mine.....		48					71	72	64
Leaming Yellow.....					57		55	61	58
<i>Tested 2 years</i>									
Henry Grady.....							121	132	127
Arnold.....					113	112			112
McMakin's Gourd Seed.....							110	108	109
Renfro.....	86	128							107
Higgins.....	72	134							103
Boone County Special.....							88	96	92
No. 77 U. S. Dept. Agr.....							73	106	90
Boone County White.....							93	79	86
Golden Beauty.....			89		83				86
Evans.....				86	81				84
Reid's Yellow Dent.....							82	84	83
Riley's Favorite.....							73	56	65
<i>Tested 1 year</i>									
Golden Giant.....	125								125
Cade Prolific.....		124							124
Yellow Dent.....	117								117
Marlboro.....								114	114
Baden.....			113						113
Local White Cob.....								112	112
Bradbury.....					112				112
Tennessee White.....						110			110
Peabody.....	108								108
Tennessee Yellow.....						106			106
Albemarle.....								99	99
Cary Klondike.....					97				97
Strawberry.....		97							97
Giant Broad Grain.....					94				94
Chester County Mammoth.....	93								93
Golden Dent.....				92					92
Poor Man.....					89				89
Welborn's Conscience.....		87							87
Cuban Giant.....			79						79
Sheep Tooth White.....					75				75
Creole.....					74				74
Snow Flake.....							45		48

*Mosby* is one of the most productive of the prolific varieties. Comparing its record with that of other prolific varieties we find that in each of six years *Mosby* yielded more than *Cocke*; in comparison with *Blount*, *Mosby* led in five out of six tests.

Comparing *Mosby* with some of the most productive non-prolific varieties, we find that it stood ahead of *Sanders* in 2 out of 3 tests, and equaled *Sanders* in the third test; once *Mosby* stood above *Henry Grady* and once slightly below. Compared with *Shaw*, *Mosby* was the more productive in 5 out of 6 tests.

Compared with all varieties tested, *Mosby* occupied *first* place in 2 tests, *second* place in 2 tests, *third* place in 2 tests, *fourth* place in 1 test and *twelfth* place in 1896, when weather conditions injured all late varieties.

*Cocke*, though averaging less than *Mosby*, proved to be one of the most productive varieties when all of our tests, made during the last ten years are considered.

In six tests its relative position was *second* in 2 tests, *fourth* in 2 tests, and *seventh* and *tenth* in the other two years.

*Henry Grady* has been tested only two years, but has taken high rank, namely *first* in 1905 and *third* in 1904.

*Sanders* has been tested only two years, but in both has taken high rank. It was *first* in 1904 (equaling *Mosby*), and *third* in 1905.

Other promising varieties as regards yield, but which have not been often tested here, are: *Bradberry*, *Marlboro*, *Arnold*, *Local White-Cob*, *Tennessee White* and *McMackin's Gourd Seed*.

For illustrations of ears of certain varieties, see Appendix.

RELATION OF NUMBER OF EARS PER PLANT TO YIELD OF GRAIN  
PER ACRE.

The following table gives the number of ears and nubbins of each variety per plant. It will be noted that even most

of the prolific varieties average less than two ears and nubbins per plant and that several varieties average less than one grain-bearing shoot per plant.

The number of grain-bearing shoots varies greatly for the same variety in different seasons, but, nevertheless, this number is largely a variety characteristic.

*Number of ears and nubbins per plant.*

Variety	1900		1901		1904		1905		Average
	Number	Rank	Number	Rank	Number	Rank	Number	Rank	
Albemarle .....	.....	.....	.....	.....	.....	.....	2.02	1	2.02
Arnold .....	.91	22	.94	10	.....	.....	.....	.....	.93
Blount .....	1.86	1	1.00	9	.....	.....	.....	.....	1.43
Boone County White .....	.....	.....	.....	.....	1.11	5	.....	.....	1.11
Bradbury .....	1.40	4	.....	.....	.....	.....	.....	.....	1.40
Cary Klondike .....	1.00	16	.....	.....	.....	.....	.....	.....	1.00
Champion White Pearl..	.99	17	.....	.....	.....	.....	.....	.....	.99
Cocke .....	1.55	2	1.85	1	1.49	2	1.60	6	1.65
Creole .....	1.39	5	.....	.....	.....	.....	.....	.....	1.39
Early Mastodon .....	1.04	10	.....	.....	.....	.....	.....	.....	1.04
Evans .....	.92	21	.....	.....	.....	.....	.....	.....	.92
Experiment Sta. Yellow	1.17	7	1.36	3	.....	.....	1.44	7	1.32
Farmers' Pride .....	.99	17	.....	.....	.....	.....	.....	.....	.99
Giant Broad Grain .....	1.03	12	.....	.....	.....	.....	.....	.....	1.03
Golden Beauty .....	1.03	12	.....	.....	.....	.....	.....	.....	1.03
Henry Grady .....	.....	.....	.....	.....	1.15	4	1.37	9	1.25
Hickory King .....	1.31	6	.91	11	.....	.....	1.38	8	1.20
Jones' Pearl .....	.....	.....	1.18	5	.....	.....	.....	.....	1.18
Leaming .....	.99	17	.....	.....	.77	11	.....	.....	.88
Local White Cob .....	.....	.....	.....	.....	.....	.....	1.10	14	1.10
Marlboro .....	.....	.....	.....	.....	.....	.....	1.86	2	1.86
McMackin's Gourd Seed	.....	.....	.....	.....	1.11	5	1.21	12	1.16
Mosby .....	1.02	14	1.60	2	1.36	3	1.74	3	1.43
No. 77 U. S. Dept. Agrl.	.....	.....	.....	.....	.85	9	1.24	11	1.05
Poor Man .....	1.15	8	.....	.....	.....	.....	.....	.....	1.15
Red Cob, Tenn.....	1.01	15	1.04	8	.....	.....	1.15	13	1.07
Reid's Yellow Dent .....	.....	.....	.....	.....	1.05	7	1.68	5	1.37
Riley's Favorite .....	.....	.....	.....	.....	.98	8	1.08	15	1.03
Sanders .....	1.45	3	.....	.....	1.61	1	1.74	3	1.60
Shaw .....	.96	20	1.12	7	.....	.....	1.27	10	1.12
Sheep Tooth, White ....	1.04	10	.....	.....	.....	.....	.....	.....	1.04
Silver Mine, Iowa .....	.....	.....	.....	.....	.85	9	.99	16	.92
St. Charles .....	1.12	9	.....	.....	.....	.....	.....	.....	1.12
Tennessee White .....	.....	.....	1.22	4	.....	.....	.....	.....	1.24
Tennessee Yellow .....	.....	.....	1.16	6	.....	.....	.....	.....	1.16



Dividing the varieties tested according to number of ears and nubbins per plant, we have the following classification:

*Prolific varieties.*

Sanders	Albemarle
Blount	Marlboro
Mosby	Cocke

*Medium prolific varieties.*

Hickory King	Creole
Jones' Pearl	Reid's Yellow Dent
McMackin's Gourd Seed	Experiment Sta. Yellow
Tennessee Yellow	Henry Grady
Poor Man	Tennessee White
Bradbury	

*Non-prolific varieties.*

Golden Beauty	Shaw
Riley's Favorite	St. Charles
Cary Klondike	Boone County White
Farmers' Pride	Local White Cob
Champion White Pearl	Tennessee Red Cob
Arnold	No. 77, U. S. Dept. Agr.
Silver Mine, Iowa	Early Mastodon
Evans	Sheep Tooth White
Leaming Yellow	Giant Broad Grain

The above classification has been made as a means of securing an answer to the question, "What type of corn has been most productive in recent tests at the Alabama Experiment Station?" An examination of the yields gives the following table of averages:

*Average yields of types of corn in bushels per acre.*

	Prolific. Bus.	Medium. Non-prolific. Bus.	Bus.
1900—Average yield .....	37.4	27.8	31.6
1901—Average yield .....	29.5	24.7	29.9
1904—Average yield .....	34.2	26.6	20.2
1905—Average yield .....	34.0	31.6	26.5
4 years, average of averages...	33.8	27.7	27.0

In three out of four years the prolific varieties gave decidedly the highest average yield. It must be stated, however, that the averages for the medium and non-prolific varieties are low largely because these lists embrace so many early non-productive northern varieties.

In the following table all early or otherwise unproductive varieties have been eliminated and a comparison made between the average yields of the best prolific, the best medium and the best non-prolific varieties.

*Average yields of best varieties of three types.*

YEAR	PROLIFIC VARS.	MEDIUM VARS.	NON-PROLIFIC VARS
	Bus.	Bus.	Bus.
1900	39. { Mosby Cocke	37. { Bradbury Expt. St. Yel.	35.9 { Shaw Red Cob Arnold
1901	33.5 { Mosby Cocke	28.6 { Expt. St. Yel. Tenn. White Tenn. Yel.	29.9 { Shaw Red Cob Arnold
1904	34.2 { Mosby Cocke Sanders	29.6 { Expt. St. Yel. Henry Grady McMackin	
1905	36.9 { Mosby Cocke Sanders Albemarle Marlboro	34.5 { Expt. St. Yel. Henry Grady McMackin	31.6 { Local Wh. Cob Red Cob
Av.	35.9	32.4	32.4

The above figures show that the best prolific varieties each year averaged higher than the best varieties bearing a smaller number of ears.

# SIZE OF EAR IN DIFFERENT VARIETIES.

Number of ears and nibblins required to shell 56 pounds of grain.

Variety	1900		1901		1904		1905		Average
	Number	Rank	Number	Rank	Number	Rank	Number	Rank	
Albemarle							168		168
Arnold	78	1	115	1					97
Blount	151	22	161	7					156
Boone County White					141	5			141
Bradbury	122	11							122
Cary Klondike	99	4							99
Champion White Pearl	139	18							139
Cocke	133	14	209	10	167	10	154	12	166
Creole	172	23							172
Early Mastodon	109	6							109
Evans	111	8							111
Experiment Sta. Yellow	120	10	161	7			130	7	137
Farmers' Pride	99	4							99
Giant Broad Grain	113	9							113
Golden Beauty	123	12							123
Henry Grady					126	1	101	2	114
Hickory King	149	21	184	9			148	11	160
Jones' Pearl			220	11					220
Leaming	147	20			135	3			141
Local White Cob							90	1	90
Marlboro							161	14	161
McMackin's Gourd Seed					134	2	106	4	120
Mosby	143	19	156	6	151	7	137	10	147
No. 77 U. S. Dept. Agri.					159	8	117	6	138
Poor Man	126	13							126
Red Cob, Tenn.	93	3	137	4			102	3	111
Reid's Yellow Dent					165	9	172	15	169
Riley's Favorite					171	11	157	13	164
Sanders	136	17			145	6	135	9	140
Shaw	97	2	121	2			108	5	109
Sheep Tooth, White	135	15							135
Silver Mine, Iowa					136	4	131	8	134
St. Charles	109	6							109
Tennessee White			136	3					136
Tennessee Yellow			149	5					149

160 Iowa Gold mine.

60 " Silver "

By means of this table we are able to make three groups of varieties according to the average size of ears and nubbins, that is according to the number of ears and nubbins required to shell one bushel of 56 pounds of grain.

A much better showing would, of course, be made for each variety if we should give a table showing the number of well grown ears required to shell a bushel. The figures in the above table are not intended to show the average weight of typical, well grown ears, but to indicate how many ears and nubbins a farmer must handle to obtain one bushel of grain. This, of course, varies widely with the season, as well as with the variety.

*Large-eared varieties.*

Arnold	Local White Cob
Cary Klondike	McMackin's Gourd Seed
Early Mastodon	Red Cob
Evans	Renfro
Farmers' Pride	Shaw
Giant Broad Grain	St. Charles
Henry Grady	Strawberry
Higgins	

*Medium-eared varieties.*

Bradberry	Poor Man's
Experiment Station Yellow	Sheep Tooth White
Golden Beauty	Silver Mine
Jones Pearl Prolific	Tennessee White
No. 77 U. S. Dept. Agr.	Welborn's Conscience

*Small-eared varieties.*

Champion White Pearl	Hickory King
Sanders	Marlboro
Leaming	Riley's Favorite
Boone County White	Cocke's Prolific
Mosby	Albemarle
Tennessee Yellow	Reid's Yellow Dent
Blount	Creole

## EARLY AND LATE VARIETIES.

Grouping the varieties according to earliness when grown in the South, we have the following groups:

*Early varieties.*

Blount	Leaming
Boone County White	No. 77 U. S. Dept. Agr.
Champion White Pearl	Reid's Yellow Dent
Early Mastodon	Riley's Favorite
Golden Beauty	Silver Mine
Golden Dent	Snowflake
Hickory King	Saint Charles

*Late varieties.*

Albemarle	Marlboro
Arnold	McMackin's Gourd Seed
Bradbury	Mexican June
Cade's Prolific	Mosby
Cocke's Prolific .	Poor Man's
Creole	Red Cob
Experiment Sta. Yellow	Renfro
Evans	Sanders
Farmers Pride	Shaw
Henry Grady	Strawberry
Higgins	Tennessee White
Jones Pearl Prolific	Tennessee Yellow
Local White Cob	Welborn's Conscience

Of course still further sub-division of each class is possible. For example, we might place St. Charles in a medium early group, and probably include Blount in the same. Subdividing the second group, we should have as medium to late, Albemarle, Marlboro, Evans; and as very late, Creole, Poor Man's and Mexican June.

The yields of the late and medium late varieties are very much greater than the yields of the early varieties.

The large-eared group consists of late varieties, except Early Mastodon and St. Charles.

The medium-eared group includes both early and late varieties, the late predominating.

The small-eared group is made up chiefly of the early northern varieties and the prolific or many-eared kinds; it thus includes both the most unproductive and the most productive varieties.

#### SEED CORN FROM DIFFERENT LATITUDES.

This series of experiments has been under way for nine years under the present management. The plots for this experiment have always been located on upland soil, naturally poor, on the Station farm at Auburn.

The northern or western seed corn used in all of these eight years has come from the same grower, J. C. Suffern, Voorhees Post Office, in the central part of Illinois, in latitude 39 degrees and 50 minutes, or about one degree north of St. Louis. This northern seed corn has been compared with, (1) seed corn of the same varieties grown in Georgia and Alabama and, (2) with seed corn from Virginia, Delaware and Knoxville, Tennessee.

Tests of this character are beset with difficulties and results are not easy to interpret, for the reason that other factors besides climate enter into the problem. The soil in which each strain has recently grown, the carefulness of different growers in maintaining the purity and excellence of their strains of corn, and other factors complicate the results. Nevertheless, the average of a number of experiments extending over nine years and made with four different varieties should afford reliable indications.

For detailed tabulated results the reader is referred to the Appendix to this bulletin.

In sixteen separate tests, in which seed from Alabama or Georgia was compared with the same variety from Illinois, the yields were in eight cases in favor of seed corn from

Alabama and Georgia and in eight cases in favor of seed corn from Illinois. The average difference in yield was only thirty five one-hundredths of a bushel per acre, in favor of northern seed. Thus the seed from the two sources proved to be of practically equal value so far as regards the average of results with Hickory King, Blount and St. Charles. These varieties may be ranked as early or medium early varieties as compared with southern varieties. Our variety tests show that they are relatively unproductive here, like all other early varieties of corn. It seems that while northern seed corn has afforded as large yields as southern in the case of early varieties, it is advisable for the southern farmer to give the preference to southern seed corn, for the reason that he cannot, in the North, obtain seed of the varieties that are most productive in the South, the season there being too short for our best southern varieties.

Comparing seed corn from Illinois and Delaware we find that each led in one test, the difference in their average yields being very slight.

In each of three tests seed grown in Virginia proved decidedly more productive than seed of the same varieties, (Hickory King and Blount), grown in Illinois. The average difference in favor of Virginia seed was 8.5 bushels per acre.

In three out of four tests, using the varieties Hickory King, Blount and Cocke the yields decidedly favored the Virginia seed, as compared with seed from Alabama and Georgia, the average difference for the four tests being 4.9 bushels per acre in favor of the seed corn from Virginia.

Using the same three varieties just mentioned and comparing seed grown at Knoxville Tennessee, with seed from Alabama and Georgia, we find that in each of four tests the advantage was with the Tennessee seed, the average difference being 2.3 bushels per acre.

Thus on the whole there was some advantage in using seed from Virginia and from the more elevated region of Tennes-

see, as compared with seed of Cocke, Hickory King and Blount grown in Georgia and Alabama.

Are these differences due to climate, or are they due to more careful selection and greater purity of the seed from certain regions? A positive answer cannot be given. The writer's own opinion is that the difference is chiefly due to selection. If this be the correct view, it follows that the only thing needed to make Alabama seed corn the equal or superior to that from any other part of the country is to improve it by careful selection. Methods of thus improving corn will be dealt with in a later publication from this Station.

In view of results here recorded and of observations made elsewhere, the writer's conclusions relative to the source from which we, of the Gulf States, may advantageously draw our seed corn may be stated as follows:

Varieties of corn from north of the Ohio river usually give smaller yields in Alabama than corn grown further south.

Seed corn from the northern corn belt is sometimes useful in the Gulf States as a means of securing a field of early maturing corn, especially when the local corn crop of the preceding year has been poor. On such early ripening patches we need not expect as large yields as are obtained from corn maturing at the usual time.

Corn from the northern corn belt has often given, in Alabama, a very poor quality of grain, which has often been too poor for marketing or for making meal.

For planting in Alabama, seed corn of late and prolific varieties may safely be obtained from any locality south of the Ohio and Potomac rivers, and perhaps slightly above this line.

Seed corn from about the same latitude as that in which it is to be grown appears to be as good as that from further north, provided it is as well selected and maintained as pure as the imported strain. Local seed corn, when pure



and well improved, has the advantage of permitting the grower to select it in the ear, the condition in which it is desirable that all seed corn, whether local or from a distance, should be received by the farmer.

Corn brought south from higher latitudes becomes later and later each year for several years after its introduction, the plant grows taller, and generally the proportion of trashy, weevil-eaten or otherwise unmarketable grain becomes less than during the first year of growth in the South.

#### TOP VERSUS BOTTOM EARS.

To ascertain whether there is any difference for seed purposes between the lower and the upper ear on plants bearing two ears, tests were made in 1903 and in 1905.

The results in 1903 with St. Charles White corn were as follows, in bushels per acre:

From upper ear.....25.0 bushels per acre.  
From lower ear.....22.8 bushels per acre.

In 1905 five pairs of plots were used, planting seed corn from five different plants of the variety Experiment Station Yellow. Plots 1 and 2 were planted with upper and lower ears respectively from the same plant, plot 3 with corn from the same plant as plot 4, and so on for each pair of plots.

*Yields in 1905 from planting upper and lower ears from the same plant.*

Plot No.	Seed corn from.	Yield per acre from	
		Top ears Bus.	Bottom ears. Bus.
1.	Top ear .....	26.3	—
2.	Bottom ear .....	—	27.7
3.	Top ear .....	30.0	—
4.	Bottom ear .....	—	29.4
5.	Top ear .....	32.9	—
6.	Bottom ear .....	—	33.1
7.	Top ear .....	28.5	—
8.	Bottom ear .....	—	29.4
9.	Top ear .....	27.1	—
10.	Bottom ear .....	—	28.6
Average 5 plots top ears.....		28.9	—
Average 5 plots bottom ears.....		—	29.6
Increase from bottom ears over top ears		—	.7

Viewing the six tests made in the two years we note that the yield was greater with seed from bottom ears in four cases and with seed from the upper ears in two cases. In 1905 the average number of ears and nubbins combined and their average size or weight were almost identical from planting upper and lower ears. This evidence is not sufficient to justify the conclusion that the bottom ear is better than a well developed upper ear, or the reverse.

#### SUBSOILING.

A tract of level rather poor upland has, for ten years, been devoted to continuous experiments in subsoiling, using different crops each year. The surface soil is made up of flinty stones and of rather stiff reddish loam. The subsoil is a very compact yellowish sandy clay, which in winter is usually too wet for the subsoil plow to do effective work. A regular subsoil plow drawn by two mules is run in the furrow made by a one-horse turn plow, giving a total depth of from 10 to 12 inches of loosened soil. Subsoiling is not done every year, but every second or third year. The following table shows that when the land for corn was subsoiled only about six weeks before corn was planted, the yield was slightly less on the subsoiled plots than on those not subsoiled. When subsoiling was done two years before planting, this operation resulted in a slight increase in yield.

#### *Immediate and third year effects of subsoiling.*

Crop grown in	When subsoiled	Yield per acre		Loss from subsoiling	Gain from subsoiling
		Not subsoiled	Subsoiled		
		<i>Bus.</i>	<i>Bus.</i>	<i>Bus.</i>	<i>Bus.</i>
1901—Never subsoiled .....		13.1	.....	.....	.....
1901—Subsoiled Feb. 1901 .....		.....	11.2	1.9	.....
1903—Never subsoiled .....		13.8	.....	.....	.....
1903—Subsoiled Feb. 1901 .....		.....	14.5	.....	.7
<b>Average loss from subsoiling ..</b>		.....	.....	.6	.....

Subsoiling should not be condemned simply on this showing. The figures, together with slightly better results on the same land with some other crops, should emphasize the fact that subsoiling done within two months of the time of planting may have an injurious effect. It is believed that land of this character would be helped by using the subsoil plow during long dry periods in the fall when the subsoil is dry enough to crumble.

#### DEPTH OF EARLY CULTIVATION.

In 1900 on rather stiff reddish soil, with flinty stones, there was no injury from making the first cultivation deep with two scooter furrows per row, all subsequent cultivations being shallow.

In 1901 on gray sandy upland the yield was 23.6 bushels on the three plots cultivated shallow and 23.4 bushels on those given an early deep cultivation with two scooter furrows per row, the subsequent cultivation being shallow. Thus in both experiments there was no marked advantage in favor of making the first cultivation deep. However, it should be noted that in both tests the first cultivation or "running around" was given when the plants were only a few inches high. If cultivation had been delayed as late as sometimes occurs, the injury from early deep cultivation would doubtless have been appreciable. When land is in good condition there seems to be no need for deep early cultivation. Possibly when clay land has been plowed early and has become badly compacted there may be some justification of "running around" the young plants with a scooter. But in general the danger of injury to roots, of excessive drying of the soil if dry weather follows, and the slowness of this process, are against this primitive method of cultivation.

#### PLANTING CORN IN WATER FURROW VERSUS ON A LEVEL.

On light sandy lands farmers frequently plant corn below the general level, or in the water furrow. This method was

compared with planting on the level flushed field, both in 1900 and in 1901.

In preparing to plant corn in the water furrow the land was thrown into beds with a one-horse turn plow, leaving unbroken until planting time a narrow balk where the corn was to be planted. When ready to plant, this balk was thrown out with a shovel plow and seed and fertilizer placed in this freshly-stirred soil. Likewise seed and complete commercial fertilizer were applied on the same day in the furrow on the plot that was planted on the level. In both cases the fertilizer was mixed with the soil before the seed were put into the ground.

The yields in bushels per acre were as follows:

	1900	1901
Planted on the level.....	22.2	16.5
Planted in water furrow.....	19.0	16.5

In 1900, in which April and June were wet months, there was a loss even on this porous soil, from planting in the water furrow. In 1901 when there was abundant rain from time of planting until June 15, but a drought from the middle of June to the middle of July, the yields by the two methods were identical.

#### METHODS OF HARVESTING CORN.

The ordinary method of harvesting corn in the Gulf States consists in stripping the blades while they are still green, a practice that is expensive in labor and in the decreased yield of grain that frequently results. In recent years in many southern localities a number of farmers have cut and shocked the plants when the shucks have colored, afterwards passing the plants through a shredder to remove and shuck the ears, and better to prepare the stalk for food and bedding. Rarely the tops are cut, bound into bundles, and cured.

An experiment covering this point was made in 1904, to secure data additional to that obtained in our earlier ex-

periments in 1896, 1897 and 1900. The yields in 1904 were as follows:

*Yield per acre of corn and forage from different methods of harvesting in 1904.*

Method of harvesting	Corn per acre.	Forage per acre.
Only ears harvested .....	25.7 bus.	00 lbs.
Tops cut and ears harvested .....	26.1 bus.	360 lbs.
Entire stalk cut and ears afterwards harvested .....	25.4 bus.	1980 lbs.
Blades stripped and ears harvested .....	25.5 bus.	415 lbs.

In 1904 there were practically no differences in yield attributable to the method of harvesting.

The table below summarizes the yield of corn in four experiments made at Auburn, the results of the earlier years having been published in Bulletins Nos. 88 and 111 of this station.

*Yield per acre of corn from different methods of harvesting.*

Methods of harvesting	Corn per acre					Average loss
	1896	1897	1900	1904	Average 4 years	
Only ears harvested .....	Bus. 34.4	Bus. 31.0	Bus. 46.9	Bus. 25.7	Bus. 34.5	.....
Tops cut and ears harvested....	30.2	29.2	44.3	26.1	32.5	2.0
Entire plant cut and shocked....	29.2	29.5	44.3	25.4	32.1	2.4
Blades stripped and ears harv't'd .....	.....	.....	45.9	25.5	.....	.....

This table shows that the average loss of grain per acre where the tops only were saved for forage was 2 bushels, or where the plant was cut and shocked, 2.4 bushels per acre. Both losses were greater than in most of the experiments at other stations. As to the effects of pulling fodder, we have data for only two years. The average of all experiments at all stations show that generally stripping the blades reduces the yield by several bushels per acre, but that under some conditions (probably when the stripping is late) no material reduction in yield occurs.

The following table shows the amount of forage derived from "fodder pulling," from topping, and from shocking.

*Yields of cured corn tops, stover and blades.*

	Average yield of Grain	Yield of forage per acre					
		1896	1897	1900	1904	Avg.	
		Bus.	Lbs.	Lbs.	Lbs.	Lbs.	
Only ears harvested	34.5	.....	.....	.....	.....	.....	.....
Tops cut and ears harvested .....	32.5	312	509	711	360	473	Tops
Entire stalk cut and ears afterwards harvested	32.1	2103	1355	1759	1980	1799	Stover
Blades stripped and ears harvested ..	.....	.....	.....	615	415	515	Blades

It should be noted that the average amount of cured blades per acre was 515, of cured tops 473 and of cured stover (leaves and stalks) 1799 pounds. It is evident that we can expect less than a ton of stover per acre on southern uplands when the yield is thirty-five bushels or less per acre.

When only the ears are harvested, partial utilization may be made of the weather-worn blades, and of leaf sheaths and tips of stalks, by pulling the ears early and turning cattle into the field. Where labor is scarce, other winter forage abundant, and a shredder not at hand, this may prove to be the most practicable method.

Considering the cost and usual injurious effects of fodder pulling, this method of obtaining forage must be condemned.

This Station is accumulating data relative to the feeding value of shredded corn stover, which may throw further light on the advisability of shocking and shredding corn, the method that is usually regarded as the best.

Assuming—in the absence of a sufficient number of exact experiments in feeding tops and stalks,—that tops are worth 40 cents, stover 30 cents per 100, and corn blades 60 cents, we find that one acre gives a value of \$1.80 in corn

tops; or of \$3.09 in corn blades or "fodder," and of \$5.40 in stover.

Cutting and shocking can be done before cotton picking begins, a merit that will be generally recognized. Moreover, the cutting of the stalks leaves the land in better condition for plowing, and enables the farmer to begin the plowing for small grain at an earlier date than is practicable when the ears are allowed to cure slowly on the living plants. The removal of the stalks is somewhat more exhaustive to the land than is burying them with the plow, but this on most soils is probably counterbalanced by the greater convenience of preparing and cultivating land that is free from stalks.

#### LEGUMINOUS PLANTS AS FERTILIZERS FOR CORN.

##### *Velvet bean stubble vs. vines as fertilizer for corn in 1901.*

In 1900 velvet beans were planted after oats in 4 feet rows on certain plots of light sandy upland adjacent to the land on which for a long period our fertilizer experiments with cotton and corn were conducted. On certain other plots corn was grown in 1900. The velvet bean vines were cut for hay on a part of the area, yielding 3332 pounds of hay per acre.

In 1901 corn was grown on all plots, using on all acid phosphate at the rate of 100 pounds per acre. The object was to note the comparative value as fertilizer of (1) the entire velvet bean plants plowed under late in winter, (2) the stubble of velvet beans, plowed in at the same time, and (3) as a check, corn stalks of the preceding corn crop.

	Yield per acre <i>Bus.</i>	Increase per acre <i>Bus.</i>
Corn following corn .....	13.6	....
Corn following velvet bean stubble.....	17.9	4.3
Corn following velvet beans, entire growth plowed in .....	25.9	12.3

The increase attributable to the plowing in of the entire growth of velvet beans, grown as a catch crop after oats,

was 12.3 bushels per acre, this increase being worth, at 70 cents per bushel, \$8.61 per acre. Doubtless there was also a considerable residue of humus and nitrogen left in the soil to increase the crop of 1902.

The cost of growing the velvet beans consisted chiefly of expenditures for 200 pounds of acid phosphate per acre, for the seed, and for a small amount of cultivation. By using the entire crop of velvet beans as fertilizer the yield of the first crop of corn was nearly doubled.

The plot on which only the stubble of velvet beans was used for hay afforded an increase of 4.3 bushels per acre, and lacked 8 bushels of giving as large a crop as the plot on which the entire growth was plowed under. Hence in deciding which was the more profitable use of the velvet bean vines we have on one side 8 bushels of corn and the saving of labor from not harvesting the hay and on the other hand the value of more than one and a half tons of hay.

As recorded in Bulletin 111 of this Station, (the issue of which is now exhausted), in 1900 on a similar and adjacent soil, the increase in yield of corn after plowing in the entire vines of velvet beans of 1899, as compared with plowing in only the velvet bean stubble, was 11.9 bushels per acre. That year the yield of velvet bean hay was 2800 pounds.

On the same plots in 1901 on all of which corn was the preceding crop, the residual fertilizing effect of the 1899 crop of velvet beans was 4.4 bushels greater where the entire growth of vines had been plowed under than where only the stubble had been plowed under. Here we have in two years a total superiority of vines over stubble of 16.3 bushels of corn per acre, which may be weighed against 2900 pounds of velvet bean hay, less the cost of harvesting the hay.

*Cowpea stubble versus cowpea vines as fertilizer for corn.*

On a poor reddish loam upland soil cowpeas were sown in drills June 13, 1900, following oats, and fertilized with 150 pounds of acid phosphate per acre.



A part of the cowpea area was cut, yielding 1648 pounds of hay per acre. On another part of the area the peas were neither cut nor picked, but the entire growth turned under.

In 1901 corn was grown on both areas, and was fertilized with 100 pounds of high grade acid phosphate per acre. The yields of corn in bushels per acre were as follows:

After drilled cowpea stubble.....	11.4 bushels
After drilled cowpeas, all plowed in.....	20.3 bushels
Excess from entire growth of cowpeas as compared with cowpea stubble.....	8.9 bushels

*Beggar weed as a fertilizer for corn.*

On June 24, 1899, beggar weed seed were sown on certain plots on a poor hilltop, where the soil is a light gray sandy loam. The growth that year was only medium and the stand poor, but some of the plants matured and shed seed.

The entire growth of beggar weed was plowed under during the winter, as was also the stubble of drilled velvet beans on adjacent plots, and all plots planted in corn in 1900 and again in 1901. After cultivation of the corn ceased in 1900 beggar weeds sprang up, reseeded the land, and this volunteer crop was plowed under as a fertilizer for the corn crop of 1901.

As compared with the plot where velvet bean stubble was left in 1899, the increase on the plots where beggar weeds were plowed in immediately preceding each corn crop was 3.1 bushels in 1890 and 7.6 bushels in 1901, an average annual increase of 5.4 bushels per acre. Doubtless this increase, especially in 1900, would have been considerably greater could the comparison have been made with some plot on which no legume had recently been grown.

*Acid phosphate as a fertilizer for corn grown after velvet beans.*

In 1901 acid phosphate containing 14 per cent. available phosphoric acid was applied to corn on poor gray sandy up-

land. No other fertilizer was used, but on both plots the entire growth of velvet bean vines had been plowed under late in the winter. The yield without any phosphate was 21.5 bushels per acre; with 100 pounds of phosphate 25.9 bushels. This difference of 4.4 bushels of corn per acre represents the effect of 100 pounds of high grade acid phosphate when applied in the presence of abundance of vegetable matter.

Likewise in 1905 a test was made to determine whether, after plowing under a luxuriant growth of velvet bean vines, it would pay to apply commercial fertilizers in addition.

On level sandy land in good condition a very heavy growth of velvet bean vines was plowed under with a disc plow February 27, 1905. On the adjacent plots on either side there was plowed under at the same time and in the same way the stubble of drilled sorghum which had been cut for hay. Two of the velvet bean plots received no other fertilizer than the vines and two of them, besides the vines of velvet beans, were also fertilized with 40 pounds of muriate of potash and 240 pounds of acid phosphate per acre.

Average results for two plots in each test are given below :

<i>Yield of corn per acre fertilized with velvet</i>	
<i>bean vines alone.....</i>	<i>21.3 bushels.</i>
<i>Fertilized with velvet bean vines, potash and</i>	
<i>phosphate .....</i>	<i>27.3 bushels.</i>
<i>Increase from potash and phosphate.....</i>	<i>6.0 bushels.</i>

In this experiment it was profitable to employ as fertilizer for corn, muriate of potash and phosphate, in addition to a mass of velvet bean vines. The gain from this mineral fertilizer, when used in the presence of an abundance of vegetable matter, was 6 bushels per acre.

A crop of velvet bean vines turned under gave practically the same yield of corn as did a very heavy application of the best grade of barnyard manure, applied on adjoining plots, at the estimated rate of about ten tons per acre.

## FRACTIONAL APPLICATIONS OF FERTILIZER.

It is a favorite plan of some farmers to apply only a part of the fertilizer to cotton or corn before planting, and to apply the remainder after growth has well begun.

After the publication of Bulletin No. 111, in which it was shown that corn had not responded very freely to large applications of commercial fertilizers, the writer received several letters suggesting that the results with fertilizers would have been much better if a part of the fertilizer had been withheld until the plants were one or two feet high.

To test this matter again eight plots were employed in 1905, located on fairly good upland, where the soil is a red-dish loam, containing many flint stones.

The fertilizer applied before planting was drilled in the planting furrows and mixed with the soil March 7, and planting was done March 29. The portion of fertilizer withheld was applied on certain plots May 15, in the siding furrows of the second cultivation.

*Fractional application of fertilizer for corn in 1905.*

Plot number.	FERTILIZER			Yield per acre	Increase over unfertilizer plots
	Amount per acre	Kind	Time applied		
	<i>Lbs.</i>			<i>Bus.</i>	<i>Bus.</i>
1	200	Cotton seed meal ....	All at planting .....	25.1	.....
	200	Acid phosphate .....			
	40	Muriate of potash ....			
2	200	Cotton seed meal ....	$\frac{1}{2}$ of fert. at planting .....	24.0	.....
	200	Acid phosphate .....	.....		
	40	Muriate of potash ....	$\frac{1}{2}$ of fert. at 2nd cult. ....		
3	00	No fertilizer .....	.....	19.4	.....
4	200	Cotton seed meal ....	All at planting .....	20.9	.....
	200	Acid phosphate .....			
	40	Muriate of potash ....			
5	200	Cotton seed meal ....	$\frac{1}{2}$ of fert. at planting .....	22.6	.....
	200	Acid phosphate .....	.....		
	40	Muriate of potash ....	$\frac{1}{2}$ of fert. at 2nd cult. ....		
6	00	No fertilizer .....	.....	20.0	.....
7	200	Cotton seed meal ....	$\frac{1}{2}$ of fert. at planting .....	24.0	.....
	200	Acid phosphate .....	.....		
	40	Muriate of potash ....	$\frac{1}{2}$ of fert. at 2nd cult. ....		
8	200	Cotton seed meal ....	All at planting .....	25.4	.....
	200	Acid phosphate .....			
	40	Muriate of potash ....			
Av. 3,6	00	No fertilizer .....	.....	19.7	.....
Av. 1,4,8	200	Cotton seed meal ....	All at planting .....	23.8	4.1
	200	Acid phosphate .....			
	40	Muriate of potash ....			
Av. 2,5,7	200	Cotton seed meal ....	$\frac{1}{2}$ of fert. at planting .....	23.5	3.8
	200	Acid phosphate .....	.....		
	40	Muriate of potash ....	$\frac{1}{2}$ of fert. at 2nd cult. ....		

Wherever fertilizer was employed a complete fertilizer, at the rate of 240 pounds per acre, was used. The average results show a difference of three-tenths of one bushel per acre in favor of applying the entire amount before planting.

In favor of this method is also the greater convenience and saving of labor.

The corn receiving the entire amount of fertilizer before planting made a much better start than did the other plots, but the difference nearly disappeared late in the season.

The increase due to 240 pounds of a complete fertilizer was only 4.1 bushels when all was applied before planting, and only 3.8 bushels when applied in two doses.

**COTTON SEED VERSUS COTTON SEED MEAL AS FERTILIZER.**

In 1901, 200 pounds of cotton seed meal was compared with 434 pounds of cotton seed, these amounts containing equal quantities of nitrogen. The cotton seed was scalded to prevent germination and all fertilizers were applied in the drill April 8. Acid phosphate at the rate of 160 pounds per acre was used on all plots.

Increase from 200 pounds cotton seed meal.....2.8 bushels

Increase from 434 pounds cotton seed.....2.3 bushels

This shows a slight superiority the first year for cotton seed meal.

An experiment made in 1897 on similar soil, comparing 200 pounds of cotton seed meal with 434 pounds of cotton seed, all applied when corn was planted, April 7, also resulted in a slight advantage for cotton seed meal.

In 1904 and again in 1905 on the same plots a comparison was made between the following nitrogenous fertilizers:

Cotton seed meal, 200 pounds per acre; cotton seed, 434 pounds; manure (unleached) from feeding steers on cotton seed meal and sorghum hay, 4800 pounds; 100 pounds of nitrate of soda; and a mixture of nitrate of soda and cotton seed meal. To prevent germination the cotton seed were scalded in 1904 and ground in 1905.

*Cotton seed meal versus cotton seed, nitrate of soda and stable manure.*

FERTILIZERS PER ACRE.		YIELD PER ACRE.			Increase per acre from nitrogenous fertilizers.		
Am't. per acre.	KIND	1904	1905	Av.	1904	1905	Av.
Lbs.		Bus.	Bus.	Bus.	Bus.	Bus.	Bus.
200	Cotton seed meal .....						
240	Acid phosphate .....	22.9	18.9	20.9	1.8	2.2	2.0
48	Muriate of potash .....						
434	Cotton seed .....						
240	Acid phosphate .....	21.0	17.8	19.1	.8	.7	.8
48	Muriate of potash .....						
240	Acid phosphate .....						
48	Muriate of potash .....	20.2	17.1	18.7	.....	.....	.....
100	Nitrate of soda, 2nd cult.						
240	Acid phosphate .....	27.3	21.1	24.2	7.1	4.0	5.6
48	Muriate of potash .....						
100	Cotton seed meal .....						
50	Nitrate of soda .....						
48	Muriate of potash .....	25.2	21.2	23.2	5.0	4.1	4.6
240	Acid phosphate .....						
33	Nitrate of soda (at plantg						
67	Nitrate of soda, 2nd cult						
240	Acid phosphate .....	29.3	24.4	26.8	9.1	7.3	8.2
48	Muriate of potash .....						
4800	Manure from steers fed cotton seed meal and hulls or sorghum fodder	24.2	22.3	23.5	4.0	5.2	4.6

This soil did not respond very generously to any of the fertilizers in either year, although it had been rather exhaustively cropped with silage corn, wheat and sorghum, and had borne no leguminous plant for at least two years before the beginning of this experiment.

It is obvious that cotton seed meal was more effective than cotton seed; that a mixture of cotton seed meal and

nitrate of soda was still more useful; and that nitrate of soda was more beneficial than any other fertilizer. One pound of nitrate of soda afforded a greater average increase than 48 pounds of manure made under shelter by feeding steers on cotton seed meal and coarse sorghum fodder. Unexpectedly there seems to have been but little cumulative or second-year effect from either cotton seed or manure. This experiment is being continued on the same plots, using wheat as the crop, and we may reasonably expect that as this experiment is continued we shall obtain some cumulative effect from the manure.

There was an advantage both years in applying one-third of the nitrate of soda with the other fertilizers before planting, instead of reserving all this for use at the second cultivation. Nitrate of soda is believed to be the only fertilizer which can be applied to corn with as much advantage after growth begins as before planting.

A number of fertilizer experiments have been made with corn. But these will not be published until some of these tests have been further repeated. In general they point to the conclusion that corn, growing on average upland soil in Alabama, usually requires a fertilizer rich in nitrogen, and that the application of very large amounts of commercial fertilizers for corn is not very profitable.

The following fertilizer formulas for corn are suggested:

- (A) 100 lbs. acid phosphate,  
50 lbs. nitrate of soda, (both just before planting).  
50 lbs. nitrate of soda, at second cultivation.
- (B) 100 lbs. acid phosphate  
200 lbs. cotton seed meal, (both before planting).

Credit is due to the following for participation in the experiments detailed in this bulletin: T. U. Culver, formerly superintendent of the farm; C. M. Floyd, superintendent of the farm during 1904 and 1905; and L. N. Duncan, assistant in agriculture, who has prepared most of the tables in this bulletin.

## APPENDIX

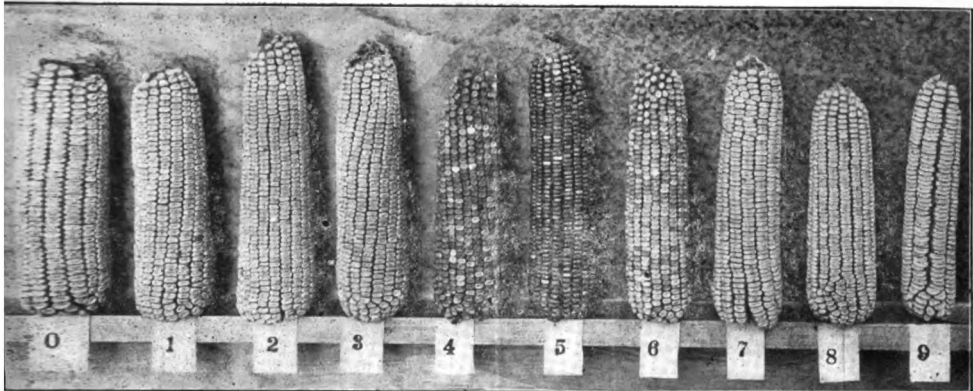
### *Seed corn from different latitudes.*

Year	Variety	Seed from	Yield per acre			Increase per acre from		
			Seed from Ill.	Seed from Gulf Region	Seed from Del. & Va.	Gulf Region over Ill. seed	Va. & Del. over Ill. seed	Gulf over Va. Del. & Tenn seed.
1896	Hickory King	Alabama	.....	16.5	.....	Bus. —2.8	Bus. ....	Bus. ....
do	do	Illinois	19.3	.....	.....	.....	.....	.....
do	do	De'aware	.....	.....	15.6	.....	—3.7	.....
1896	Blount Prolif	Ga. (South)	.....	13.1	.....	—1.1	.....	.....
do	do	Illinois	14.2	.....	.....	.....	.....	.....
1897	Hickory King	Alabama	.....	12.1	.....	—2.2	.....	.....
do	do	Illinois	14.3	.....	.....	.....	.....	.....
897	Blount Prolif	Ga. (South)	.....	18.9	.....	— .2	.....	.....
do	do	Illinois	19.1	.....	.....	.....	.....	.....
1898	Hickory King	Ga. (North)	.....	11.4	.....	1.0	.....	.....
do	do	Illinois	10.4	.....	.....	.....	.....	.....
1898	Blount Prolif.	Ga. (North)	.....	11.0	.....	.5	.....	.....
do	do	Illinois	10.5	.....	.....	.....	.....	.....
1899	Blount Prolifi.	Georgia	.....	17.1	.....	1.9	.....	.....
do	do	Illinois	15.2	.....	.....	.....	.....	.....
1899	St. Charles	Alabama	.....	15.3	.....	— .8	.....	.....
do	do	Illinois	16.1	.....	.....	.....	.....	.....
1900	St. Charles	Ala. (1 year)	.....	34.2	.....	1.1	.....	.....
do	do	Illinois	33.1	.....	.....	.....	.....	.....
1900	Blount Prolif.	Ga. (South)	.....	32.2	.....	1.9	.....	.....
do	do	Illinois	34.1	.....	.....	.....	.....	.....
do	do	Virginia	.....	.....	36.8	.....	2.7	—4.6
1900	Cocke Prolif.	Ga. (South; J.)	.....	32.6	.....	.....	.....	.....
do	do	Ga. (South; A.)	.....	38.4	.....	.....	.....	.....
do	do	Ga. (North)	.....	38.6	.....	.....	.....	.....
do	do	Virginia	.....	.....	41.7	.....	.....	—5.2
1900	King Hickory	Virginia	.....	.....	29.8	.....	.....	.....
do	do	Delaware	.....	.....	20.4	.....	.....	.....

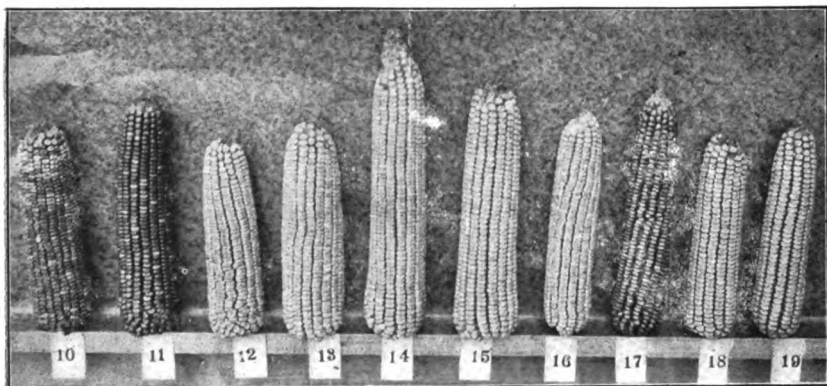


*Seed corn from different latitudes. (Continued).*

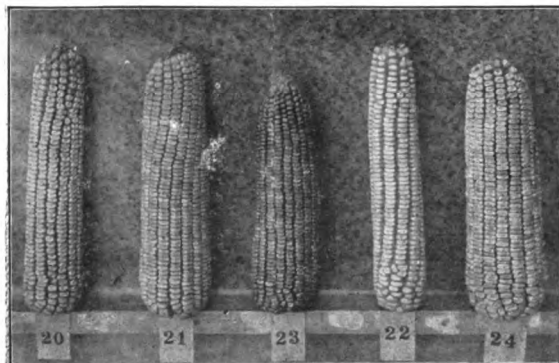
Year	VARIETY	Seed from	Yield per acre		Increase per acre		
			Seed from Illinois	Seed from Gulf Region	Seed from Va., Del. and Tenn.	Gulf Region over Va., Del. and Tenn.	Va., Del. and Tenn. over Ill. seed
1901	Blount .....	Georgia ..	22.6	...	...	...	...
do.	Blount .....	Illinois ..	27.3	...	...	-4.7	...
1901	St. Charles White .....	Alabama ..	18.9	...	...	...	...
do.	St. Charles White .....	Illinois ..	24.6	...	...	-5.7	...
1903	Hickory King .....	Georgia ..	20.7	...	...	.6	...
do.	Hickory King .....	Tenn. ....	...	24.3	...	...	-3.6
do.	Hickory King .....	Illinois ..	20.1	...	...	...	4.2
1903	St. Charles White .....	Illinois ..	23.5	...	...	...	...
do.	St. Charles White .....	Alabama ..	...	23.9	...	.4	...
1904	St. Charles White .....	Illinois ..	20.5	...	...	...	...
do.	St. Charles White .....	Alabama ..	...	27.7	...	7.2	...
1904	Cocke .....	North Ga ..	31.2	...	...	.8	...
do.	Cocke .....	Virginia ..	...	30.4	...	...	...
do.	Cocke .....	Tenn. ....	...	33.4	...	2.2	...
1904	Hickory King .....	Virginia ..	...	31.7	...	-10.7	11.8
do.	Hickory King .....	Illinois ..	19.9	...	...	...	...
do.	Hickory King .....	Delaware ..	...	22.7	...	-1.7	2.8
do.	Hickory King .....	North Ga. ..	21.0	...	1.1	...	...
do.	Hickory King .....	Tenn. ....	...	22.0	...	-1.0	2.1
1904	Blount .....	Virginia ..	...	25.2	...	...	...
do.	Blount .....	Illinois ..	14.3	...	...	...	10.9
1905	Cocke .....	Alabama ..	28.6	...	...	...	...
do.	Cocke .....	Tenn. ....	...	30.9	...	-2.3	...



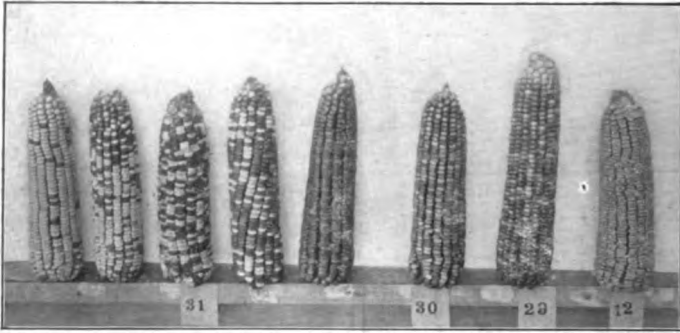
*Fig. I. 0, 1 and 2, Boone County White; 3, Boone County Special; 4, Leaming; 5, Experiment Station Yellow; 6, Reid Yellow Dent; 7, No. 77 U. S. Dept Agr.; 8, Iowa Silver Mine; 9, Hickory King.*



*Fig. II. 10, Kiley Favorite; 11, Experiment Station Yellow; 12, Sanders; 13, McMakin's Gourd Seed; 14, Local White Cob; 15, Henry Grady; 16, Mosby; 17, Experiment Station Yellow; 18, Marlboro; 19, Cocke.*



*Fig. III. 20, Cocke; 21, Shaw; 22, Albemarle; 23, Experiment Station Yellow; 24, ...*



*Fig. IV. 31. Lead colored Mexican June and crosses: 29 and 30, Experiment Station Yellow, with cross on lead colored Mexican June; 12, Sanders, with few lead colored grains.*



*Fig. V. White (or ordinary) Mexican June Corn.*

35. #135?

JUNE, 1906.

ALABAMA



# Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute,

AUBURN.

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## Diseases of Sweet Potatoes in Alabama.

(A Preliminary Report.)

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By

E. MEAD WILCOX, Ph. D.,

Plant Physiologist and Pathologist.

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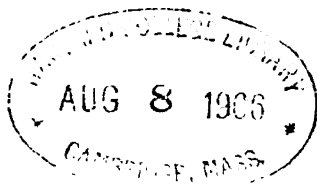
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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.



# DISEASES OF SWEET POTATOES IN ALABAMA

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E. MEAD WILCOX, PH. D.

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## INTRODUCTION.

The sweet-potato crop in Alabama is one of importance and one that, no doubt, will increase in value from year to year. At present Alabama stands fourth in order among the sweet-potato growing states. According to the census report for 1900, covering the year 1899, Alabama produced 3,457,386 bushels of sweet potatoes on 50,865 acres. Assuming the average value of the crop as \$0.49 cents per bushel, as done in this report, the average value of this crop per acre during 1899 was \$33.17. The following counties produced over 100,000 bushels: Dallas, Henry, Jefferson, Montgomery and Wilcox; and Montgomery county produced 163,832 bushels.

The value of the crop is much enhanced if it is possible to hold it until it can command the much higher prices that prevail during the winter and early spring. Methods of storage, therefore, deserve attention and it is our plan to make a thorough investigation of the subject in connection with some of the growers who now try to hold over a part or all of their crop. Some of the diseases which are mentioned in this bulletin are most serious obstacles to the storage of sweet-potatoes, and it is here largely, rather than during the growing season, that sweet-potato diseases cause the greatest losses. It has seemed wise in advance of the publication of our study of storage methods to publish here a summary of our present knowledge of sweet-potato diseases to include the work upon the subject done here and elsewhere.

It is hoped and urgently requested that all who grow sweet potatoes will assist us in this investigation by reporting all sweet potato diseases to this office promptly, accompanied by specimens of the diseased plants. In this manner



# CHICKEN-POX, SORE-HEAD OR CONTAGIOUS EPITHELIOMA IN POULTRY

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By C. A. CARY.

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## INTRODUCTION.

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This disease occurs in nearly every county in Alabama during the spring summer or fall of every year. It is more prevalent among young chickens, from broilers to maturity; yet younger and older chickens may have this disease. It is a common poultry disease and very probably more deaths occur from sore-head than from any other poultry disease in Alabama. Such a high mortality can be avoided with proper care and treatment.

The poultry industry in Alabama is not as extensive and as carefully and thoroughly worked as it should be. The extensive home markets in the mining and manufacturing regions of the South will take care of a much larger supply of chickens, ducks, turkeys and pigeons. The conditions in the South are ideal if the poultry business is conducted with that care and knowledge which are required in any place to bring success. With a small capital, plenty of regular work applied intelligently, it will bring as good returns as any line of the live-stock industry.

## FORMS OF THIS DISEASE.

There are no positive differences between the various forms of diphtheria, roup and chicken pox or "sore-head" other than the locality in which the lesions occur; and possibly the per cent. of mortality in the different forms of the disease. Usually when the mouth, throat, air passages or alimentary canal in one or more places is peculiarly inflamed so that an organized or solid exudate is formed on the surface of the inflamed mucous membrane and that mem-



brane bleeds rather freely when the diphtheritic exudate is torn away—such a diseased condition is called fowl (avian) *diphtheria*.

If the nasal passages and the cavities connected therewith have their mucous membrane inflamed producing a catarrhal (mucous) exudate, or solid, dried pus-like exudate in the nasal cavities, and sometimes pushing outward the tissues around the eyes—such a diseased condition is called “roup.”

If the skin of the wattles, comb, ear lobes, eyelids or of the head and sometimes the conjunctiva (the mucous membrane lining, the eye-lids and reflected over the front part of the eye-ball) becomes inflamed in such a way as to produce crusts or scabs or an exudate of dried pus, broken down epithelial cells, etc—such a condition is called chicken-pox or “sore-head” or *epithelioma contagiosum*.

#### CAUSES.

The causes of these diseases, or this disease, have been attributed to coccidia (one-celled protozoa) to various bacteria and to ultra-microscopical organisms.

Neumann (11) gives the following:

“*Coccidia* or *Psorospermiae oviformes* constitute, in the class of sporozoa, an order in which the majority of the species belonging to it live as parasites in the interior of epithelial cells of the liver, intestine, skin, etc. At the commencement of their development these coccidia form small protoplasmic regularly rounded masses, which are usually nucleated. Gradually each of these masses increases in volume and becomes surrounded by a transparent membrane—the *cyst* or *shell*—and rupturing the cell into which it had penetrated, it falls into the biliary ducts, the intestine, the epidermic layers, etc. Thus liberated, the encysted coccidium passes through a phase of segmentation—its protoplasm becoming condensed, then dividing into several spheres or spores,

Each spore in its turn subdivides into a number of corpuscles—*falciform corpuscles*—which, meeting with favorable conditions each becomes a new amoeboid individual that invades an epithelial or epidermic cell, grows there and recommences the cycle of its progenitor.”

Osler tag (9) says:

“Coccidia are parasites of epithelia. They are small, spherical or oval structures which destroy the epithelial cells by their rapid growth and then divide into a number of parts. These penetrate into the intact epithelia of the infested organ (*merozoites*) or become changed into microgametes and macrogametes (male and female sexual cells). By the copulation of these forms sporoblasts are produced and, finally, permanent forms with shells (*sporozoites*) arise. The latter cause infestation of new hosts.” The sporoblasts (a) are elongated, oval and surrounded by a double capsule, at first the protoplasm entirely fills the capsule as a coarsely granular mass, but soon becomes contracted into a sphere from which four sporozoites arise. In the rabbits’ liver infested with coccidia, round, white, abscess-like foci are formed.

Friedberger and Frohner (13) give the following:

Coccidia “are at first naked inhabitants of epithelial cells. By penetrating into the cells of the mucous membrane and by filling up these cells (in many cases completely, so that the enclosed coccidia assume the appearance of large nuclei), they produce grave disturbance of nutrition and this tends to induce necrosis of the parts attacked.” “Gregarious croupy diphtheritis is distinguished by the ease with which the disease extends from the mouth to the skin of the head. It can be readily transmitted artificially, and is generally not difficult to cure, especially when it is confined to the mucous membrane of the mouth, pharynx, upper part of larynx and skin.”

“The clinical phenomena of avian gregarious (coccidian) diphtheritis agrees in all particulars with those of bacterial

diphtheritis when these respective complaints affect the mucous membrane of the head. Here, also, the symptoms are essentially those of croupy diphtheritis of the mucous membrane of the mouth, pharynx, air passages of the head, larynx, conjunctiva, etc., with secondary intestinal affections. Gregarines may also give rise to primary and independent enteritis (Zurn)."

"In gregarinous diphtheritis, the skin is much more frequently implicated than in diphtheritis caused by bacteria. The cutaneous affection consists of hypertrophied nodules on the skin, which are known as gregarinous epitheliomata (*epithelioma gregarinosum* of Bollinger, and are identical with *molluscum contagiosum* of man.). Their favorite seats are those parts of the head that are not covered with feathers; root of the beak, neighborhood of the nostrils, angles of the mouth, lobes of the ear, parts adjacent to the auditory meatus, wattles, surface of the face, edges of the eyelids, intermaxillary space, and especially the comb. They sometimes spread over the feathered parts of the head, throat and neck, and may occur on the outer surface of the thighs, abdomen, under the wings and in the vicinity of the cloaca. At first these epitheliomata appear in the skin, as flat nodules, which soon become prominent, and which vary in size from a poppy seed to a millet seed. Later on, they usually attain the size of a hemp seed. They are of a reddish-grey or yellowish-grey color, often show distinctly in their earlier stages of development a peculiar greasy, nacreous lustre; and are rather firm to the touch. Their surface soon becomes covered with a dirty-grey, yellow-brown or red-brown crust. They are discrete and disseminated in considerable numbers on the erectile tissues, etc. They vary in size according to their age; and frequently lie rather close to one another, so that the affected parts looks as if coarsely granulated; or they are crowded together in such a manner as to give the appearance of large warts with divisions through them, or mulberry-like hypertrophies. Even single

nodules, to say nothing of groups, may attain the size of a lentil, pea, cherry-stone, broad bean or larger object. The older they become the rougher, and more covered with knobs will be their incrustated surface."

"If the edges of the eye-lids be affected by these tumors, the lids will become nodular, swollen and closed. The conjunctiva in this case also suffers; it projects outward; becomes catarrhally inflamed; assumes a yellowish color at the seat of eruption; and its surface become covered with crusts. Purulent conjunctivitis may appear and the inflammation may spread to the sclerotic and cornea, with keratitis and panophthalmia as the result. If, as sometimes happens with pigeons, the eruption of nodules extends over the whole of the skin of the eye-lids and its neighborhood, the entire eye will become covered with mulberry-like proliferations of various sizes.

#### COCCIDIA IN ANIMALS.

Coccidia (*C. oviforme* and *perforans*) have been reported as occurring in the following places in animals.

1. Leuckart (7) and many others have found coccidia in the bile ducts of rabbits there attacking the epithelium of the ducts, and in many cases causing the death of the rabbits.

2. Johne (8) and Ostertag (9) report coccidia in the liver of swine.

3. Birch-Hirschfeld (10) states that coccidia have been found "in the respiratory passages of rabbits, dogs, cats, calves, sheep, and birds, producing circumscribed or diffuse inflammation of the mucosa and submucosa, even superficial ulceration, which in many instances appears as infectious and results in numerous fatalities. He calls especial attention to the diphtheritic inflammation in the mucosa of fowl; its extension to the intestinal mucosa and the mesenteric lymph glands.

4. Ostertag (9) says *C. perforans* is found in the intestinal epithelia of rabbits producing a desquamative catarrh

of the entire intestinal tract and in consequence profuse diarrhœa.

5. Ostertag (9) also reports that in some of the Swiss cantons there is a disease called "dysenteria hæmorrhagica coccidiosa." The coccidia are found in the longitudinal folds of the mucous membrane of the colon and were oval or spherical and contained nuclei three times as large as those of epithelial cells. One observer says these are *C. ovi-forme*.

6. Ostertag (9) also reports *Coccidium tenellum* as an epizootic, croupous, diphtheritic enteritis in poultry and during the progress of the disease or infestation the coccidia invade the mesenteric lymph glands producing disintegration foci.

7. Friedberger and Frohner (13) state that coccidia are very widely distributed as parasites in the animal kingdom and are found in birds, rabbits, rats, dogs, fish, snails, and earthworms. The diphtheritic products contain cast-off epithelial cells which contain in their interior a rounded body which fills up half or more of the cell-space and looks like a greatly enlarged nucleus. These bodies are highly refractive and have a greasy, glassy lustre, and swollen homogeneous appearance. These spherical formations are also found free and in varying numbers in the croupy diphtheritic excretions of skin nodules in coccidian diphtheria of chickens.

8. Moussu and Marotel (15) report coccidia in the intestines of sheep producing hyperæmia and necrotic lesions in the mucosa.

9. Eckardt (16) found *Coccidium tennuum* in great numbers in the intestines of chickens, producing diarrhœa, great emaciation and intensely blue comb and wattles.

10. According to Nocard and Leclainche, (14) Rivolta, in 1869 found coccidia in the false membranes of diphtheria.

11. Thoma (18) says *C. perforans* has been reported as occurring in man, dogs, cats, rabbits and mice.

*Coccidia* (*Coccidium oviforme*) has been reported as occurring in the following diseases or conditions in man:

1. In the intestinal canal in two instances (2).
2. In *contagious epithelioma (molluscum contagiosum)* (1) a skin disease in man.
3. According to Leuckart (3) numerous cases of coccidia in the liver of man have been reported by Virchow, Dressler, Sattler, Peris, etc.
4. Padwyssozki (4) reports a case of extensive infestation of the liver of a man.
5. Peters (5) reports "ingekapselta gregarinen"—coccidia—in the diphtheritic membrane of six cases of diphtheria in man.
6. Leuckart (3) reports the records of Lindemann who found coccidia in the human kidney and also in one instance on the hair of the head of a young girl, where it was supposed to cause considerable irritation.
7. L. Pfeifer (6) reports coccidia in small-pox lymph.

The life history of coccidia has not been completely worked out. Johne, in Birch-Hirschfeld's book, (10) gives the characters and life history of *coccidium oviforme* as studied in rabbits. He says it is 0.03 to 0.037 Mm. long and 0.015 to 0.02 Mm. broad. The mature form consists at first, of the finely granular protoplasm which occupies the entire space in the cell (a fig. 5). In this stage the shell or wall of the cell may be quite thin but later it becomes thicker and apparently double contoured. In the next stage the protoplasm becomes contracted into a spherical granular mass (b fig. 5). In about four weeks (?) the protoplasm is divided into 4 round granular spore-like bodies (c fig. 5) which later become the C-shaped bodies as observed in d. e. and f. in fig. 5. When these are taken into the stomach of a rabbit, the old capsule is dissolved and the spores or embryonic masses are set free and have amoebic-like movements and characters; in this condition they pass

from the intestine into the bile ducts where they penetrate the epithelial cells and develop into the stage (a) in fig. 5. In doing this they destroy the epithelial cells.

The following bacteria have been found in diphtheria, roup and sore-head in fowls:

Loeffler (26) in 1884 found a bacterium in diphtheria of pigeons and claimed that he produced the disease by inoculation with pure cultures of the germ.

Loir and Ducloux (27), Haushalter (28) and Quaranta (29) have found a bacillus or motile germ in the diphtheritic exudate of fowls.

Moore (25) in 1895 isolated from chicken diphtheria a bacterium belonging to the haemorrhagic septicaemia group. In later years he failed to find this germ in other outbreaks. Moore states that the real cause of diphtheria, roup and chicken-pox has not been discovered.

Cornil and Megin (30) in 1885 found a germ similar to Loeffler's bacterium in lesions of the mucous membrane and of the skin of fowls.

Von Krajewski (31) discovered the bacterium of Loeffler in the lesions of poultry and transmitted the disease to pigeons and young chickens by inoculation on the mucous membrane.

Babes e Puscarin (32) found the Loeffler germ in the diphtheria of pigeons and described its mode of action in the tissues.

Eberlein (33) in 1894 found a bacillus in the diphtheria of the partridge.

Harrison and Streit (21) discovered in the blood under the diphtheritic exudate of roup or diphtheria in chickens and pigeons a short motile germ (*Bacillus cacosmus*); and after passing the pure culture through pigeons to intensify its virulency, produced the disease in healthy chickens by inoculation. They also isolated the green pus germ (*Pseudomonas pyocyanae*) from the lesions in chickens and produced the disease by inoculation. Moreover they found

bodies in and among the epithelial cells of the exudates and tissues; these bodies may represent stages in coccidial life. They also found yeast cells in the diphtheritic exudates.

Gallez (34) isolated from the lesions in nasal mucuous membrane of chickens having contagious coryza (roup) a germ that he claimed was identical with the Klebs-Loeffler germ of human diphtheria.

Ferre (35) reports that he found the human diphtheria germ in the lesions of chicken diphtheria and he also found the germ on the mucous membranes of healthy chickens.

Gratia and Lienaux (36) isolated from diphtheritic pigeons a germ that closely resembles the human diphtheria microbe.

Harrison (23) made a number of tests with human diphtheria antitoxine and for the human diphtheria germ in chickens and pigeons and could not produce diphtheria in chickens by inoculating them with the human diphtheria germ. He also failed to find the germ of human diphtheria by examining over two hundred chickens affected with roup or diphtheria. He concludes that there is no relation between human and fowl diphtheria.

Guerin (37) makes a positive statement that there is no relation between human and avian diphtheria.

Moore, in his *Pathology of Infectious Diseases of Animals* gives the following records:

"The non-identity of these diseases (human and avian diphtheria) has been clearly pointed out by Menard (43). Although these maladies are shown by several observations to be unlike in their etiology and character of the lesions, the transmission of fowl diphtheria to the human species, and vice versa, is affirmed by several writers."

"Gerhardt (38) reports four cases of diphtheria in Wesselhausen, Baden, among six workmen who had charge of several thousand fowls, many of which died of diphtheria. There were no other cases of diphtheria in the neighbor-



hood and the evidence was quit conclusive that the disease was contracted from the affected fowls."

"Debie (39) reports briefly the transmission of human diphtheria to fowls. He is inclined to believe that human diphtheria is transmissible to fowls and fowl diphtheria to man. Cole (42) reports a case of supposed transmission of the disease from a fowl to a child."

"The diphtheritic disease of fowls reported by Loir and Ducloux (27) in Tunis, in 1894, spread to the people of that place, resulting in an epidemic of serious proportions. Menard (41) refers to the fact that men employed to feed young squabs contracted diphtheria by blowing the masticated food into the mouth and crop of squabs suffering with that disease. Schrevens (40) reports several cases of diphtheria in children in which he traces the sources of infection to certain poultry."

"Guerin (37) has pointed out with emphasis that there is no relation between diphtheria in man and in fowls."

Moore further states that until the relation between human and fowl diphtheria is positively determined it is wise to handle diseased fowls with care and especially keep all susceptible children away from diphtheritic chickens and pigeons.

M. Juliusberg (Deut. Med. Wochenschr, 30 (1904), No. 43, pp. 1576-1577), study of contagious epithelioma of pigeons and chickens is reviewed by Wilcox in the Experiment Station Record, for April, 1905, as follows:

"As a result of the study of the cause and symptoms of these diseases as well as the virus, it is found that the virus of pigeon-pox may be filtered in the same manner as the virus of chicken pox.

The incubation period of both pigeon and chicken pox after inoculation with filtered virus is about twice as long as after direct inoculation with the substance of the tumors (nodules or crusts). It was found that the repeated passage of the virus of pigeon-pox through animals

attenuated it to such an extent that it finally became non-virulent. The addition of erythrosin in 1 per cent. solution destroyed the virus. None of the pure cultures of yeasts, cocci, or bacilli obtained from contagious epithelioma were found to be pathogenic for pigeons or chickens.

#### BACTERIA OBTAINED FROM SORE-HEAD CASES.

(a) Dec. 2 1903. Obtained following germ from crust of naturally infected chicken:

Long, round end bacillus, usually in filaments forms spores: 1.6 to 2.8 long and 0.5 micro-millimeters wide; slightly motile, flagella peritrichic; takes Gram's stain. Blood serum growth crumpled becoming mealy and greyish white.

Agar plate—growth on surface irregular, streaming and to naked eye appears like ground glass. Agar stroke is rugose, becoming mealy and grey-white. Gelatine liquified and pellicle on surface. Bouillon—at first a crumpled film; then mealy, flaky pellicle; flaky precipitate. Litmus milk coagulated and peptonized slowly. Gas is produced in lactose bouillon.

Potato growth is at first watery, and later becomes white crumpled and mealy.

This germ is closely related to *bacillus subtilis*. Inoculated a field lark with negative results.

(b). Dec. 6, 1903, obtained following germ from eye exudate of sore-head chicken:

Bacillus 1.5 to 2 times as long as broad. In old cultures it appears beaded. It is motile. Does not liquify gelatine; in gelatine stab the growth is filamentous; colony on surface has wavy edges and is finely granular. Colony on agar surface white, finely granular, edges even or slightly lobed; colony two-zoned. Hydrogen and carbon dioxide gas in glucose bouillon. No gas in sacchrose bouillon. Inoculated field lark by smearing scarified conjunctiva. Negative re-

sults. Inoculated chicken by smearing scarified conjunctiva—negative results.

(c). Germ from sore-head chicken, taken from blood under crust on comb. Oval or short rod with round ends; 1 to 1.6m long by 0.4 broad; and agar white round raised colony: does not take Gram's stain; motile with peritrichie flagella; forms irregular light grey growth on surface of litmus gelatine; does not liquify gelatine; on neutral agar light gray growth. On potato the growth is gray in 24 hours and later becomes brown. It decolorizes litmus milk and coagulates it. Produces gas in acid, lactose agar and increases the acid color.

Tested by smearing sacrificed surface on chicken and by injection under skin. Negative results.

(d) Germ obtained from sore-head crust; coccus occurring in masses, sometimes single and sometimes short chains; growth on gelatine surface a wax-like yellow and very slight growth in depth. Gelatine not liquified; germ non-motile; takes Gram's stain; a lustrous yellow growth on blood serum. No gas in glucose, sacchrose or lactose bouillon. This germ was not tested by inoculation.

(e) Germ derived from crust of sore-head chicken. Large germ round ends; not motile; does not take Gram's stain; very slow growth in depth of gelatine at room temperature; in agar stab growth largely along depth of stab; slight brownish growth on blood serum; alkaline bouillon slight turbidity; acid bouillon heavy turbidity and precipitate at bottom of tube. This germ produces fermentation in glucose sacchrose and lactose bouillon. It may be a coli group germ or the *Bacterium aerogenes* of Escherich.

Inoculation of one chicken failed to give positive results.

(f) Obtained from crust of sore-head chicken, a coecus with following characters: It appears in two's, chains of six or eight and in masses; is motile and has one flagellum; it takes Gram's stain; yellow line growth from stroke on blood serum; milk not coagulated, yellow growth collects at

bottom; in bouillon yellow or white cloudy growth at bottom; colonies on agar surface produce diffuse cloudiness; does not liquify gelatine; on potato the growth is slow and yellow. Inoculated pigeons (b) and (c) with negative results. This germ corresponds closely to Chester's description of *Planococcus citreus*.

(g) Yeast.

(h) A streptococcus—negative results from inoculation.

(i) A germ that stained like a young culture of human diphtheria bacilli. Unable to transmit it by inoculation.

(j) *Pseudomonas pyocyanae*. Found quite common in all forms of sore-head, roup and avian diphtheria.

(k) Molds of various kinds are often found in sore-head crusts.

#### INOCULATION TESTS.

Inoculation tests with *Pseudomonas pyocyanae*, other germs, and exudate from natural cases of sore-head.

1. Brown chick, 3 months old. December 1, scraped rose comb and left wattle ; then rubbed into raw places green pus germ (pure culture from sore-head case).

December 8—Very slight indications of the inoculation taking hold.

December 15—Distinct thickening of skin on comb.

December 25—Well developed sore-head growth on comb.

2. Gray chick, 3 months old. Injected December 15 aqueous suspension of some green pus germ into left wattle and into comb.

December 25—Fairly good case of sore-head on comb.

3. Hen, 1 to 2 years old. Injected 1cc of acid bouillon culture of green pus germ under skin of head and into wattle. No appreciable effects.

4. January 17, 1903. Brown chick, 5 months old. Inoculated by scarifying comb and injecting under skin with a big coccus obtained from Adam's sore-head rooster. Result negative.

January 17, 1903. Injected under skin in 4 places and into comb of young chick a short thick bacterium from

Adam's cock. Chick died January 20. Liver, kidneys, intestines, lungs, all contained the germ (septicaemia).

This germ was a short bacterium that coagulates milk; does not liquify gelatine and forms white growth on surface and a villous growth along the gelatine stab; white, even cloudy, growth on surface of agar; white, watery, glistening growth on potato; white even surface growth on Loeffler's blood serum. In neutral bouillon, it gave a thin film on the surface and slight turbidity; a granular growth formed finally at the bottom of the tube.

5. Oct. 3. Scarified inner surface of eye-lid of hen and smeared over this *streptococci* obtained from sore-head case. Negative results.

6. Feb. 2, 1903. Black chick 5 months old inoculated with a coccus and a mould obtained from sore-head case. Injected the coccus and mold under skin below the eye and into the base of the comb; chick died February 6 of septicaemia without showing any signs of sore-head.

7. Dec. 1. Inoculated cockerel, 16 months old, in right wattle with 1.4 cc of big bacillus (bouillon culture). No results from this. At same time rubbed in *pseudomonas pyocyanae* on sacrificed comb.

Dec. 4. The comb above the scarified place showed red and swollen papillæ and skin at base of papillæ was yellowish green.

Dec. 10. One tooth of the single comb slightly involved.

Dec. 15. Digit or tooth on comb still involved and other teeth or digits of comb appear slightly involved.

Dec. 30. Scab came off and comb recovered.

Jan. 12. Scarified side of comb and rubbed in material from fresh natural case of sore-head—no results beyond the effects of scarification.

8. Post-mortem on chicken (4 mos. old) died of sore-head; it had small white diphtheritic patches in mouth, pharynx, oesophagus and larynx. Had been sick 10 days. Body light and very poor. Indications of diarrhoea by

soft feces covering feathers below the anus. Crust on comb, wattles, skin of head and on eye-lids, and in corners of mouth. Yellowish exudate in conjunctival sac larger than eye-ball, cornea partly destroyed and whole eye inflamed. Plate cultures from the eye exudate gave a large bacillus apparently *bacillus subtilis*; *micrococcus albus* and a germ that liquifies loeffler's blood serum and stain like the human diphtheria germ showing the beading. But this germ from cultures did not produce any form of the disease by smearing over scarified surfaces of skin, comb, eye-lid and mouth.

Archibald R. Ward (20) makes the following records:

Inoculated 17 cockerels with solid or semi-solid exudates applied to broken skin of head. Only one developed sore-head. Four out of the 17 developed nasal discharges resembling roup. The same case that showed sore-head developed diphtheritic lesions (not stated where). One case developed nasal (roup) discharge by exposure to another chicken in same cage. This would seem to indicate that roup, sore-head and diphtheria in some cases were associated in the same chicken or that the causes of these so-called diseases were sometimes found in one chicken. Ward has proven that faulty ventilation or exposure to draughts in California does not cause roup or sore-head.

#### INOCULATIONS OF PIGEONS WITH GERMS AND MATERIAL FROM SORE-HEAD IN CHICKENS.

(a) Inoculated pigeon with bacillus from blood obtained of a sore-head chicken. Blood taken from directly under sore-head crust. Hanging drop showed almost pure culture of short oval, motile germ. Blood was injected and injected under skin of head with *Planococcus citreus* and smeared. This had no effect on pigeon.

(b) Pigeon smeared on scarified inner surface of eye-lid and injected under skin of head with *planococcus citreus*

obtained from sore-head case and cultivated in alkaline chicken bouillon. No results.

(c) Pigeon—Used the same germ as in (2) in the eye, the nose and under skin. No results.

(d) Oct. 18, 1905. Inoculated a pigeon with aqueous suspension of material from eye of sore-head chick. Injected material under skin of breast and smeared it over eye-lid. This material contained numerous green pus germs and a few micrococci.

October 31 this pigeon died. At point of inoculation was an abscess surrounded by characteristic green coloration of the green pus germ. Liver hyperæmic, also lungs and kidneys. Cocci in blood.

Oct. 31. Inoculated under skin another pigeon with blood from heart of above pigeon. Results negative.

#### TESTS WITH MOSQUITOES AS CARRIERS OF THE VIRUS.

(a) One Cockerel—Rhode Island Red.

Previously had one attack of nasal roup.

Two pigeons—grown.

Three grown hens.

Two chicks half grown.

One hen that had sore-head the year.

One young common cockerel.

All were exposed for three months from May 1 to August 1, 1905, to mosquitoes, (*Culex* and *Stegomyia* varieties). Rain barrels were kept close to the coops where numerous mosquitoes could be grown and easily get at the chickens. Not one case of sore-head. All kept in shed and the weather was quite damp and air very moist most of the time.

(b) Oct. 24, 1903, confined two hens and one rooster in a coop which was placed over a barrel of water from which mosquitoes were constantly hatching. Nov. 3 one hen had developed sore-head. All three of these chickens had a

naturally acquired case of sore-head the previous winter.

At the same time (Oct. 24) four chicks (one-half grown) were confined in another coop in same room, and on November 3, two (2) chicks developed sore-head.

These chickens and the barrel of water were all confined in a room, where green pus germs were plentiful and the germ was present in the water in which the mosquitoes were developed and also found in the sore-head lesions. The mosquitoes were not tested for the green pus germ.

(c). At my home in Auburn, a hen with six chicks kept her chicks at night under a dense growth of honeysuckle vines. Three out of the six chicks developed sore-head. This was in November and mosquitoes were quite numerous about the honeysuckle vine. Another hen had four chicks in a coop 100 feet away from this vine and they did not contract sore-head. The chicks of the two hens mingled more or less in the day time.

A lady in Texas has recently reported to me that she has found that roaches are the carriers or the cause of sore-head in chickens; that when she exterminated the roaches the sore head cases disappeared. This is by no means conclusive, but suggestive.

The CAUSE or CAUSES of avian diphtheria, roup and sore-head have not been definitely determined. It appears that Loeffler's Bacterium and Harrison's *Bacillus cacosmus* and the *Pseudomonas pyocyanae* have some claim as casual factors. But the records and tests do not seem to place any one of them as always the primary or real cause. There is much evidence that the real or primary cause is an ultra-microscopic organism and belongs to that group of disease-producing organisms which are classed with the causes of small pox, cow pox, sheep pox, contagious foot-and-mouth disease, possibly yellow fever and some other diseases.

According to Ward exposure to air draughts does not cause "roup" in California.



*Transmission and Dissemination.*—It is evidently infectious; because the disease in all its forms, spread rather rapidly from one chicken or pigeon to another. Ward, Harrison and others have transmitted, in some cases quite readily by carrying small amount of diseased material (exudate and blood), from a sore-head chicken to healthy chickens. It is also, quite certain that chicken pox and pigeon pox are identical or one and the same disease.

Mosquitoes, gnat flies, chicken mites, (ticks) chicken lice, chicken foot mites (*sarcoptes mutans*) and possibly cockroaches may sometimes be the carriers of the real virus. It seems quite certain that mosquitoes can transmit the virus from water or some other source, under certain conditions. Warm and wet weather seems to increase the virulency of the virus and favor the rapid transmission of the disease. It is not impossible that ants may have a role to play in the transmission or cause of sorehead.

*Pathological Anatomy.*—On the skin the small, greasy-like nodules, or hypertrophied nodules of the skin, contain epithelial cells that have in them "greasy" refractive bodies that stain yellow with picro-carmin and the nuclei of the epithelial cells become "reddish brown" in color. Nearly all of the epithelial cells in the nodule appear larger than normal and contain the refractive bodies. In the younger epithelial cells these bodies (young coccidia?) are relatively small and occupy one-fourth to one-third of the epithelial cell cavity. In the older or outer or cast-off epithelial cells these refractive bodies are said by Friedberger and Frohner to occupy the entire cavities of the epithelial cells. The invaded or infested epithelial cells are unusually larger than the epidermal cells of the healthy neighboring skin. Among the cast-off mass of epithelial cells are found round refractive bodies and numerous nuclei of leucocytes or pus cells. The subcutaneous connective tissue is hyperaemic (congested) and is infiltrated with cells (leucocytes and nuclei of disintegrated cells).

Possibly some of the small nuclei-like bodies among the cells in the subcutis (see fig. 7) may represent one stage in the development of coccidia. Many observers have, also, found various bacteria in the nodule and subcutis.

In the diphtheritic membranes on the mucuous surfaces of the mouth, pharynx, larynx and oesophagus, the epithelial cells are sometimes invaded by refractive bodies in the same manner as the epithelial cells of the skin and in the mass of diphtheritic exudate and cast-off cells on the mucous surface may be found the well formed coccidia, usually in the stages (a) and (b) as indicated in fig. 5. But the refractive bodies are not found in the epithelial cells of mucuous exudates or of skin nodules in every case. I have found them only in the early development of the nodule and the diphtheritic exudate, and have never found the mature coccidium in the nodules of the skin.

When the exudate on the mucuous surface or the crust of the nodule of the skin is torn off the raw surface bleeds rather freely and a fresh mount of this blood contains a short oval bacillus, numerous round bodies (see fig. 7.) usually said to be nuclei of leucocytes; and a few polynuclear leucocytes. Repeated inoculations in the comb, wattles, skin and conjunctiva and oral mucosa of healthy chickens of various ages, with this blood, fresh from under a nodule or a diphtheritic exudate, has failed to produce positive infective results. I have also tested it on pigeons with like negative results.

The exudates on the mucuous membrane of the throat mouth or larynx appear to be very much alike in all forms of the disease.

The CLINICAL SYMPTOMS of sore head are quite clearly described in the quotation from Friedberger and Frohner on page 23 of this bulletin. The crust-like nodules on the skin of the head, comb, wattles, and eye lids are quite common. The mucuous membrane (conjunctiva) of the eye may be involved and a large amount of tears or serum

and organized exudate fill the conjunctival sac or the cavity formed by the closure of the eye-lids. The cornea of the eye ball may become ulcerated and destroyed by pressure of the exudate and extension of the inflammation to the cornea. In some cases the entire eye ball may be destroyed by pressure of the exudate and inflammatory processes.

There may be croupy diphtheretic membranes in the mouth, pharynx, larynx, trachea and oesophagus; also in the nasal passages and air cells or cavities connected with these passages. When the larynx or trachea are affected there may be difficult breathing, as wheezing or rattling in the throat. When the nasal mucosa is involved, a nasal mucous discharge will appear; and when the lower orbital sinus becomes filled with semi-solid mass of pus, etc., a prominent swelling will appear under and around the eye; that half of the hard palate in the roof of the mouth becomes twice its usual width and bulges into the mouth cavity. At the first appearance of this enlargement, pressure on it may produce a discharge from the nostrils. At first this enlargement under and around the eye may be soft and if then opened will be found to contain quite a thick, pus-like liquid: but later the enlargement becomes hard, and if then opened is found to contain a mass of white or yellowish granular or flaky pus, more or less dry.

If the inflamed process has been progressing for some time about the mouth, throat, etc., the infection may extend to the intestinal mucosa and there diphtheritic infiltration may appear attended by diarrhoea with watery, bad smelling feces, sometimes the feces becomes mucilaginous, or bloody. This usually causes stupor, dullness, depression and death. If the head only is involved, the affected chicken may retain its good appetite and general health and make a nice recovery in 10 to 20 days. In some badly affected cases of the nasal form (roup) the appetite will remain good, but the affected bird becomes gradually more and more emaciated.

The PERIOD OF INCUBATION is said to vary all the way from 2 to 20 days. In December I placed a newly-purchased barred Plymouth rock cock (18 mos. old) in a yard with my chickens, many of which were recovering from sore-head, and in 24 hours this cock developed a good case of sore-head on the wattles, comb and eye-lids. There were mosquitoes in the roosting house. The period of incubation varies with mode of transmission, virulency of the virus, the weather (rapid in damp warm weather and slower in cool and dry weather,) and the age and condition of the chicken or pigeon. Chicks from broiling size up to 7 or 8 months old seem to be most susceptible. Chickens with large combs seem to be more susceptible than birds with small combs and wattles.

Affected birds may recover in 2 to 8 weeks.

The mortality is said to vary from 50 to 70 per cent. of the affected birds. I judge this a low per cent. of losses if birds are left to themselves without proper care or treatment. But if individual treatment is patiently and regularly applied the mortality can be cut down to less than 20 per cent. If only the skin of the head, and the comb and the wattles are involved, one should lose less than 10 per cent. If the mouth and pharynx are also involved, less than ten per cent. should die. But if the nasal passages and infra-orbital sinus is filled with pus, or the larynx and trachea are involved, or the intestines become involved,—good care and treatment may save 50 to 80 per cent.

*Immunity.*—It is possible that one attack of sore head makes the bird insusceptible to a second attack. I have noticed that old chickens that have passed, at least two summers, are rarely affected and I have been unable to infect chickens that have had one attack of any form of the disease, except in a few cases.

*Treatment.*—Iodoform, creolin, lysol, creosote, carbolic acid, permanganate of potash, corrosive sub limate, chlorate of potash, chloride of lime, nitrate of silver, boric

acid, tincture of iodine, sulphate of copper, sulphate of iron, zinc sulphate, salicylic acid, and many other drugs have been recommended. It is possible that a number of the above drugs may be useful if properly applied. Friedberger and Frohner advise "the application by brush of a solution of corrosive sublimate (1 or 2 parts in 1,000 of water), or one of creolin (1 to 2 in 100 of water)." This they say is especially effective when the disease is localized.

I have found nothing better or more effective than iodoform by itself; or iodoform 1 part and tannic acid 1 part; or iodoform 1 part, boric acid 1 part and tannic acid one part. It is best to wash the head, wipe out the mouth and throat with a weak solution of creolin (1 or 2 to 100), using a boiled cotton or medicated absorbent cotton swab. Next remove the crust on the skin, comb, wattles and eye-lids and the exudate from the eyes, the mouth and throat. Then with sterilized or boiled or absorbent cotton wipe away the blood on the raw surfaces until they cease to bleed; then with cotton swab cover the raw places with iodoform or either of the iodoform powders above mentioned. Do not be afraid to put iodoform into the eye or the conjunctival sac. The next day or the same day a few hours later, apply freely vaseline or fresh lard all over these places. In some cases it may be necessary to apply the iodoform or iodoform powders once a day for two or three days, and thereafter apply freely only lard or vaseline every day. In other cases one application of the iodoform and daily applications of lard and vaseline are all that is required. In bad cases, especially where they do not improve as rapidly as they should, give internally, as much as a teaspoonful of vaseline, containing a few drops of creosote, or 10 to 30 grains of Epsom Salts in 1 tablespoonful of water. This may be given once per day or once every other day; it usually prevents intestinal infection or complications.

In cases where "roup" predominates, or where the sub-orbital sinus becomes filled with pus and the eye is greatly dis-

tended, there are several lines of treatment that may be followed. In the early stages apply sweet oil or olive oil to the nostrils and if possible inject some of this oil into the nasal passages by using a small nozzle and syringe. After injecting or applying the oil, apply pressure over the distended parts and thus expel as much of the pus as possible. This may be repeated twice per day. Also in the early stages of roup, the diseased birds may be placed in a moderately tight room and there steamed in this way: Fill a large bucket or a kettle a little more than one-half full of hot water; now put into the bucket 1 tablespoonful of creolin and the same quantity of turpentine; then drop into the bucket a red hot iron, weighing 5 to 10 pounds. Let the affected chickens breathe this steam for 10 to 20 minutes. If the room is too small or too close, you might scald or suffocate the chickens; this can be prevented by regulating the entrance of fresh air at the door or windows. This may be repeated once per day, for a week or longer if it improves the condition of the birds.

When the distension is hard or firm, there is no way to remove the dry pus from the sub-orbital sinus except by opening the sinus. This can be done by cutting into it below the lower eye-lid and parallel to the border of the lid; remove the pus: wash out with weak creolin or other disinfectant and stitch it up.

Chickens with affected eyes must be fed by hand.

*Prevention.*—No doubt, it can be introduced into a flock of birds by bringing in an affected bird, and this should always be avoided. But I have seen it appear on farms and in yards where no new birds had been introduced for 6 months or more. However, in such cases, pigeons or other wide ranging birds may have introduced it. Sore-head has occurred in Alabama, so widely extended as to embrace nearly every county, every year for the past 15 years. The cause or virus may live over from year to year or it may pass the winter in a second host. Isolation of sick from well birds

is advisable and wide ranges, dry, well ventilated and clean roosting houses will materially aid in checking the extension of the disease. The conditions that favor the propagation of mites, ticks, lice, mosquitoes and roaches are favorable to the extension and excessive virulency of sore-head in all its forms. Hence, old and filthy nests, damp, hot and filthy roosting houses; filthy and close brooding coops; poorly drained and small, unclean yards; dirty water and filthy water and feed vessels; sour, fermenting, rotten, musty, or spoiled feed of any kind—should all be avoided; not only as means of preventing sore-head in all its forms, but also to help keep out all other infections and maintain the vigor and health of the flock. Cleaning, white-washing, spraying with disinfectants, should be practiced at least once per month during outbreaks of sore-head, and once every two or three months as wise and profitable sanitary and preventive measures.

#### Some of the Cases Treated.

1. Plymouth rock cockerel, 5 months old. Had several scabs on head. Removed the crusts once and applied vaseline every day. Recovered in two weeks.
2. Plymouth rock grade, 4 months old. Several crusts on head. Removed crusts once and applied vaseline and 5 per cent creolin. Recovered in 2 weeks.
3. White Leghorn hen, 2 years old: had sore-head crusts all over comb and large yellow exudate in eye. From the eye almost pure culture of *psedomonas pyocyanae* was obtained. Removed crusts from comb and exudate from eye: applied equal parts of iodoform and tannic acid to comb and put into eye. Repeated every day for three days; then used vaseline every day. Recovered in 18 days.
4. Rhode Island Red cock, 1 year old. Had sorehead and eyes were distended from a collection of dry pus in sub-orbital cavities. In other words this cock had sore-head and roup. Applied vaseline to crusts on head and gave

vaseline per mouth, and tried to work it into nostrils. This cock recovered from skin sores on head and at times appeared to improve in the roup conditions in nasal sinuses. He never lost his appetite but was continually poor or thin in flesh. He died or was killed one night by some animal.

5. Common hen with distended eyes from pus in one nasal sinus. Opened below eye and removed pus; washed with 3 per cent. creolin; stitched up; recovered in 10 days.
6. Light Bramah hen, 2 years old; head one mass of crusts; both eyes filled with exudate and closed. First removed crust from skin of head and exudate from eyes. Applied iodoform and tannic acid to the head and eyes, once per day for three days: then applied daily vaseline. Recovered in 18 days. Had to feed this hen by hand for several days until she could see to eat.
7. Common hen with crusts on head and diphtheritic exudate in mouth and throat. Removed the crusts from the head and exudates from the mouth and throat. This always leaves raw bleeding surfaces. Applied iodoform and tannic acid to raw surfaces. Repeated this for 4 days; then applied vaseline once each day, some days gave one-half teaspoonful of vaseline and a little 3 per cent creolin internally. This is done to destroy and eliminate germs or parasites that may pass into the alimentary canal when the throat and mouth are at first involved. This hen recovered in 15 days.
8. In flock of 75 White Bramahs and White Leghorns, a large number of the young chickens 2 to 8 months old and many of the old hens contracted "sore-head." The disease appeared in June and cases appeared among these chickens from that time until the last of August. Many of the chickens were very badly involved. The disease was confined usually to the skin of the head, to the eyes, the comb and wattles. A few cases had the mucosa involved and there diphtheritic exudates appeared. Quite a



- number of cases developed nasal discharge. These cases were treated with vaseline. The crusts were removed and vaseline applied. Thereafter vaseline was applied once per day for 3 or 4 days and then every other day. The exudate in the eyes mouth and throat was forcibly removed and vaseline applied freely. Ninety per cent. recovered.
9. In a brood of 9 chicks, hatched in October, when three weeks old, 6 of them developed sore-head and sore mouth. The eye-lids and the eyes (conjunctival sac) and the mouth and throat were involved. In this case the chicks had what is usually called sore-head with sore mouth or diphtheria of mouth and throat. This combination is not uncommon. In fact nearly every case of chicken pox or sore-head has sore-mouth in some form and also some discharge from the nasal openings indicating the presence of "roup." These chicks were treated with iodoform and tannic acid once per day for 3 days and then pure fresh lard was applied daily. All but one recovered in three weeks.
  10. In large number of White Leghorns sore-head and distended eyes from roup exudate in nasal passages appeared. Nearly all died where the dried exudate collected in nasal passages but large per cent. of the cases of sore-head recovered by removing the crusts and applying fresh lard.
  11. One man reports trying "Mercurial Ointment" on sore head chickens and that it failed to cure them.

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## EXPLANATION OF PLATES.

- Fig. 1.*—Sore-head crusts on comb, eyelids and skin.
- Fig. 2.*—Head of hen that recovered from bad case of sore-head. The bare places on the skin around the eye give some idea of the extent of the crusts. This case was treated with creolin and vaseline.
- Fig. 3.*—A case of sore-head with eyes badly involved and a large diphtheritic ulcer with prominent exudate on roof of mouth or hard palate.
- Fig. 4.*—Same case as fig. 3 with mouth opened to show the exudate on hard palate.
- Fig. 5.*—(By Johnne in Birch-Hirschfeld's Pathological Anatomy). It represents the stages in the life history of coccidia. See description on page 27.
- Fig. 6.*—Shows epithelial cells of the skin from sore-head case. The coccidia are supposed to enter the epithelial cell and destroy its contents or take the place of the body of the epithelial cells.
- Fig. 7.*—Illustrates the cells found in blood taken from immediately under a sore-head crust. rbc. are nucleated red blood cells. wbc. are white blood cells or leucocytes. sf. are the nuclei of white blood cells or are free "sporozoites" or a free spore-like stage of coccidia.
- Fig. 8.*—Section of the mucous membrane of pharynx of chicken. d. is the diphtheritic exudate (early stage) containing coccidia. m. is the mucuous membrane. mg. are mucuous glands.



Fig. 1.



Fig. 2.





Fig. 3.

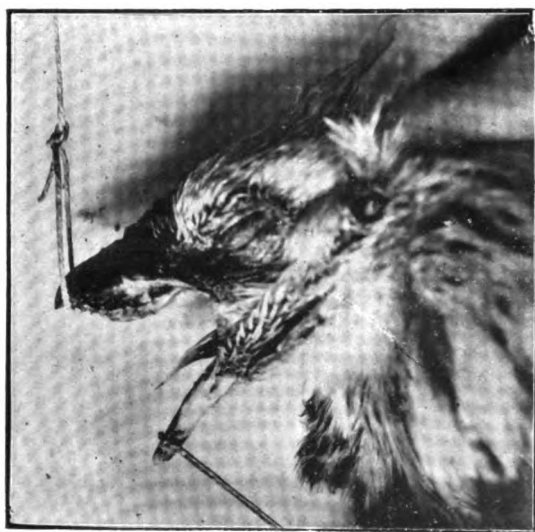
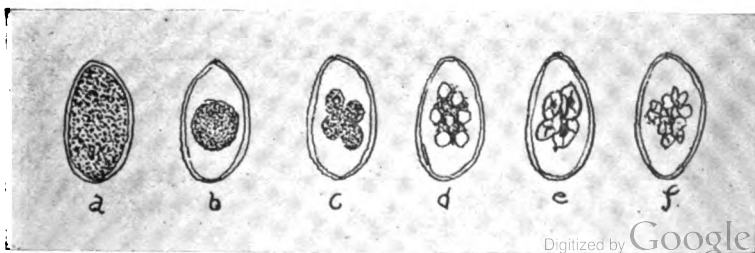


Fig. 4.







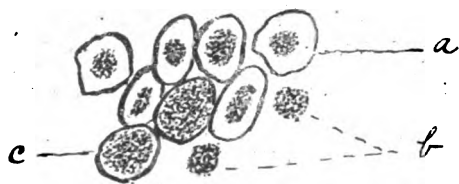


Fig. 6.

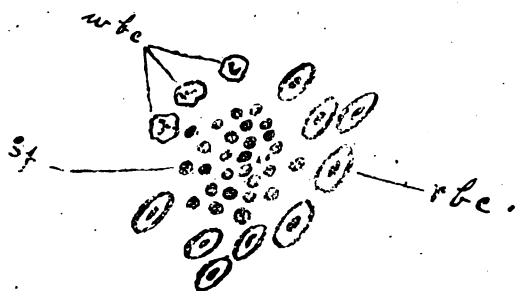


Fig. 7.

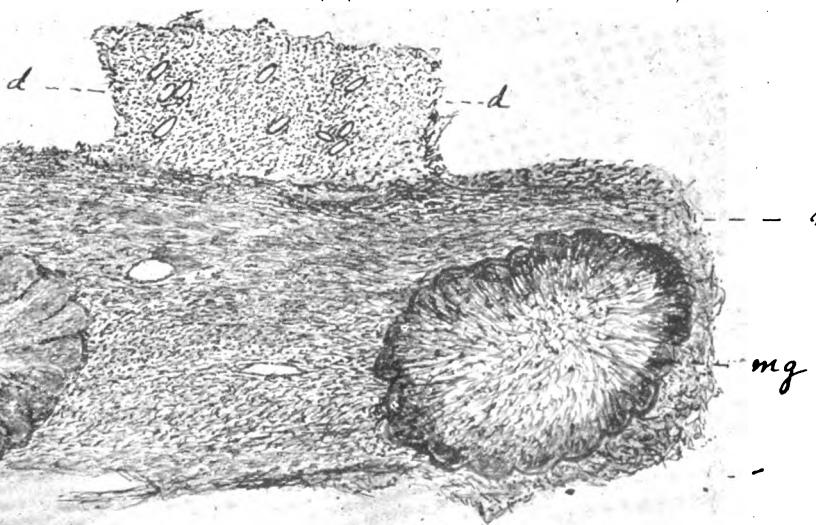


Fig. 8.



APPENDIX.

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A few words on sanitary conditions in the poultry business may help some poultrymen out of difficulties.

The *water supply* for poultry should be the very best. Fresh water in clean, uncontaminated vessels should be kept constantly within reach of the chickens, or all kinds of poultry, especially during the hot weather. Good well water is preferable to running surface water. Protected earthen-ware vessels, or any form of water vessel, should be so constructed that it can be cleaned. In fact it should be cleaned daily with boiling hot water.

The *Feed* is responsible for the health, growth and flesh of poultry. Young chicks are often over-fed and usually fed in filthy places or in unclean troughs or vessels. More young chicks die from over-feeding, and sour, fermenting, discomposing feed than from any other cause. Especially is this true where mashes or liquid or moist feed is used. Some poultrymen use milk with bread or coarse meal in it. Milk is a good food; but if given to chickens it must be fresh or it should be boiled or cooked with the bread or meal in it and fed as soon as sufficiently cooled. Always feed it in clean vessels, not in too large quantities and never leave the excess to sour. In feeding milk and all forms of moist feeds to chickens be sure to thoroughly clean and boil or scald out the feeding vessels once or twice per day during hot weather. Look well to the chick feeds. Many of them are made of refuse corn, wheat sorghum and other grains. As a rule it is best to make your own mixed grain feeds and then you will know the quality of each grain ingredient and will not be compelled to pay grain prices for the heavy grit that is so plentiful in the average mixed chicken feed. It is cheapest and safest and best for the health and growth of the chickens or other fowls to buy the separate grains and the grit and do your own mixing.

The chicken houses should be separated from all other

buildings and all the sides should be of lattice work or quite open during the summer; the north, east and west may be closed during late fall and winter. The floors, roosts and nests should be so arranged as to be readily removed, cleaned and disinfected. Portable or movable chicken houses are useful if so built that they will not come to pieces when moved. In case of infection with disease germs or of infestation with mites, intestinal parasites, lice, etc., it makes the work of disinfection and eradication of parasites more easily and quickly and permanently done, if the house can be quickly moved to a new uninfected locality.

Most chicken coops are too close, too heavy and too inconvenient to clean. Some one should invent a "knock-down" brooding coop that can be cleaned readily and one that will not easily break and retain firmness and solidity when set up.

The yards and runs are usually too small and insufficient in number. Poultrymen can greatly lessen their work by having large runs or yards and many of them.

The placing of 20 to 40 chickens in a small yard (say 50 x 100 feet) and keeping them there 8 to 12 months in a year is one of the means of intensifying the propagation of intestinal parasites of all kinds. The degree of infestation of a yard or run or poultry house depends upon the size the number of poultry kept in them; the length of time poultry are kept in them; and, to some extent, on weather conditions. A large area, as a yard or pen, will not become alarmingly infested with intestinal or other parasites as quickly as a small area. Likewise, the fewer the birds and the shorter the time the birds are kept in a given place, the less, in degree, the infestation. This often explains why a man with very few chickens having good feed and wide range, can raise fine, healthy birds. But when this same man attempts to raise a large number on a small range, yard or run, he fails and his chickens are less vigorous or

healthy and consequently less profitable. The number of houses, coops, yards and runs should always be in excess of the immediate demands. Suppose a man has yards, runs, houses and coops for 3 different lots of chickens. He should at least have 3 extra yards and runs into which he could shift the disinfected houses coops and birds as soon as the other yards or runs became infested. It would be best to have yards and runs sufficient in number to enable the poultryman to make three or four shifts before coming around or back to the first. This may seem extravagant but it is the only means by which you can breed healthy, vigorous birds without an immense outlay in cleaning and disinfecting yards or runs. Immediately after vacating a yard or run, plow it up and seed it down to wheat, rye, oats, barley, cowpeas, sorghum or anything that will make a growth upon which the chickens can graze when brought back to this yard or run. Young chicks should not be allowed to range over ground where old chickens run; if it be possible, have the young chicks in a run or yard where no old chickens have been for 6 or 8 months. This will prevent young chicks from becoming infested with round worms and tape worms.

In purchasing a new chicken, or a new lot of chickens, have them confined in some place remote from the flock for one to four weeks. During this time you will determine the presence or absence of such an infectious disease as fowl cholera. This precaution may save your flock and the difficulty of disinfecting houses and yards.

Chicken mites are the most common pests in nests and houses. Cleanliness is the best means of preventing their multiplication. They developed best in filthy nests and in cracks and under boards in chicken house. Clean the house (move if portable) and then spray the house with kerosene oil emulsion. If possible apply tar in the cracks and under roosting boards and this will catch many which escape the spray. Clean and spray the infested houses and coops

once per week and dip the infested chickens in weak kerosene oil emulsion, or a 2 to 4 per cent creolin solution. Never dip chickens in a poorly mixed kerosene solution. It will blister the skin, if the kerosene is not thoroughly emulsified. The copper sulphate solution if applied hot will kill mites. It should not be applied on the chickens.

Every farmer or poultryman in Alabama should take one or more good poultry journals, and get all the bulletins on poultry from the department of agriculture at Washington, D. C. and the bulletins on poultry published by the state experiment station and also secure Salmon's book on Poultry Diseases. Please report to me all the outbreaks of poultry or other infectious animal diseases that may occur in your vicinity or on your farm. Make these reports, at least once every year.

Kerosene oil emulsion is made as follows:

Dissolve 1-2 pound of hard soap in one gallon of hot water; add 2 gallons of kerosene and stir or churn until a milky mixture (or emulsion) is formed: now add 8 to 10 gallons of water; stir or mix with a spray pump, or keep the first emulsion of soap, water and kerosene and use as much of it as you desire after diluting with 8 to 10 parts of water.

Copper Sulphate Solution.—Dissolve 4 to 6 pounds of copper sulphate (blue stone) in 20 to 50 gallons of water. Spray this over dusted or cleaned boards, walls, nests or other places. When dry, or the next day, whitewash with spray or brush. If applied hot this copper sulphate solution will kill mites.

Government White Wash.—“Half a bushel of unslaked lime, slaked with warm water. Cover it during the process to keep the steam. Strain the liquid through a fine siene or strainer. Add a peck of salt previously well dissolved in warm water, three pounds of ground rice boiled to a thin paste and stir in boiling hot a half pound of powdered Spanish whiting (Plaster of Paris) and a pound of glue

which has been previously dissolved over a slow fire, and add five gallons of hot water to the mixture. Stir well and let it stand for a few days. Cover up from dirt. It should be put on hot. One pint of the mixture will cover a square yard if properly applied. Small brushes are best. There is nothing that compares with it for outside or inside work and it retains its brilliancy for many years. Coloring may be put into it and made of any shade, Spanish brown, yellow or common clay."

This is good for chicken houses, etc., to fill up small cracks and make a smooth surface. To it may be added two pints of carbolic acid, which will make it a disinfectant.

List of a few drugs and their uses for the poultryman:

For Intestinal Worms:

1. Isolate infested birds and destroy or disinfect their droppings while being treated.
2. Put one to 2 drams of copper sulphate in each gallon of drinking water, for one week: or
3. Powdered Pomgranate root bark (for tape worms) followed by 2 or 3 tablespoonfuls of castor oil: or
4. Oil of turpentine, 1 to 2 teaspoonfuls, followed in 4 to 6 hours with castor oil.
5. Powdered santonin in 5 to 8 grain doses is especially good for round worms.
6. Chopped-up pumpkin seed for tape worms.

For worms in the air passages:

1. Turpentine introduced by stripped feather, into the windpipe.
2. Steaming with creolin and turpentine in the hot water.
3. Feeding garlic in the food.

For Diarrhoea:

1. Subcarbonate of Bismuth. 1 to 4 grains. 2 to 3 times per day; or
2. Pulv. cinchona bark. 1 to 2 grains 3 times per day and
3. Quinine 1-8 to 1-2 grain 2 times a day.
4. Dry feed or cooked and slightly moist feed.



**Constipation :**

1. Epsom Salts.—20 to 30 grains in 1 tablespoonful of water; or
2. Castor oil. 1 to 2 teaspoonfuls; or
3. Calomel, 1 to 2 grains; and
4. Soft feed.

**For Lice:**

1. Lard, or vaseline over head, under wings and around anus.
2. Dipping in 15 per cent. kerosene oil emulsion; or
3. Dipping in 2 to 5 per cent creolin solution.
4. Pyrethrum powder dusted among the feathers.
5. Clean nests yards and houses.

**For intestinal disinfectant:**

1. One-half to 2 drams of copper sulphate in one gallon of drinking water; or
2. One-half to 2 drams of iron sulphate in 1 gallon of drinking water; or
3. Salol 1-2 to 1 grain, once or twice daily.
4. Naphthol 1-2 to 1 grain, once per day after eating.
5. Resorcin 1-4 to 1-2 grain once per day after eating
6. Hyposulphite soda, 4 to 10 grains in one tablespoonful of water

**FOR CHICKEN MITES.**

1. Lard or vaseline on legs, feet and head applied once or twice per week. Wash off scales.
2. Kerosene Emulsion sprayed on walls, roosts, floors and nests once per week for what is commonly called chicken mites or chicken ticks.
3. Two to 5 per cent creolin solution sprayed on same places as (2).
4. Formalin 1 part to 200 parts of water sprayed as (2).
5. Corrosive sublimate (very poisonous) 1 part to 1000 parts of water sprayed as (2).
6. Boiling hot water freely applied by pouring over walls, roosts, nests and floor.
7. Clean Chicken house every day until mites are gone.



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**SEPTEMBER, 1906**

**ALABAMA**  
**Agricultural Experiment Station**  
**OF THE**  
**Alabama Polytechnic Institute,**  
**AUBURN.**

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**Experiments With Cats**

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**By**  
**J. F. DUGGAR,**  
**Director**

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Alabama.

# EXPERIMENT WITH OATS

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By  
J. F. DUGGAR.

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## SUMMARY.

Experiments extending over a period of ten years are summarized in this bulletin.

The oat may be made a much more profitable crop in Alabama than it now is, provided farmers will make the two following innovations in the usual method of caring for the crop; (1) Sowing in the early or middle fall. (2) Applying nitrate of soda as a top dressing in March, or sowing on land where a soil-improving crop like cow peas has recently grown.

In tests of varieties extending over a number of years there was little difference in the yields of Red Rust Proof, Appler, and Culberson when sown in the fall. These three varieties are practically identical.

When sown after Christmas the Burt or May oats averaged 7 per cent. less grain than did the Red Rust proof variety.

Turf or Grazing oats sown in November afforded only 59 per cent. as much grain as Red Rust Proof oats sown at the same time. The order of ripening of the principal varieties sown in the fall was Burt, Red Rust Proof, and Turf.

Red Rust Proof oats may be distinguished from other varieties usually grown in the South by the long beards which are usually present on both grains, by the brownish yellow color, by the plumpness of the grain, and still more positively by the greater length of the tiny hairs or bristles located at the base of the lower grain.

Red Rust Proof and related varieties or strains, Appler and Culberson, constitute the best general-purpose type of oats for this region, being suitable for either fall or February sowing, and having stiffer straw and greater rust-resistance than any other variety tested.

The Burt oat, (synonym May oat), is chiefly valuable for its earliness, and hence for sowing at a rather late date in spring. When sown in November it was almost completely winter killed in the severe winter of 1904-5, but it was uninjured during the mild winter of 1905-6.

Winter killing of oats may be greatly reduced and the crop almost insured against ordinary winters by using one or more of the following methods:

- (1) Sowing in deep drills.
- (2) Sowing in October.
- (3) Sowing with a grain drill.
- (4) Use of a roller after the plants have been heaved and their roots exposed.
- (5) The use of Turf oats in the northern part of the cotton belt.

The average of seven experiments made in seven different years shows that Red oats sown in November averaged 11.3 bushels per acre more than when sown in February. This is a profit of \$5.65 per acre, or an increase of 73 per cent. as the result of sowing in the fall. October is advised for fall sowing, and the first few days in February for spring sowing in this latitude.

Oats sown in deep furrows, about two feet apart, yielded more than broadcast sowing, the increase being 3.2 bushels per acre when the deep furrows were only partly filled, and 2.3 bushels when the furrows were almost completely filled. Planting in deep furrows only partially filled is recommended only for well-drained soils.

Smut of oats can be entirely prevented by moistening the

seed in a mixture of one ounce of formalin and three gallons of water.

Nitrogenous fertilizers have been much more profitable than phosphate or potash on the sandy and loamy soils at Auburn, but it is recommended that on such soils at least 100 pounds of acid phosphate be applied at the time of sowing oats.

Among the various nitrogenous fertilizers a pound of nitrogen or a dollar of investment has been most effective in nitrate of soda, and somewhat more effective in the form of cotton seed meal than of cotton seed. When either cotton seed or cotton seed meal is used it should be applied at the time of sowing, but nitrate of soda is most useful when used in March after growth begins.

Barneyard manure greatly increased the yield of the crop of oats to which it was applied, and exerted some effect on the next crop. In one experiment it required 43.1 pounds of nitrate of soda and 103 pounds of acid phosphate (costing together \$1.93) to afford the same increase as one ton of fine, fresh, unleached horse manure.

In thirteen experiments with nitrate of soda the yield and total profit per acre increased with the amount of nitrate applied up to 200 pounds per acre. However, the smaller applications were more economical. The cost of nitrate of soda required to produce one additional bushel of oats was 14.5 cents from the use of 63 pounds per acre; 17.7 cents when nitrate was applied at the rate of 100 pounds, and 21.1 cents when 200 pounds of nitrate of soda was used per acre. The smallest application afforded a profit over the cost of fertilizer of 249 per cent.; the use of 100 pounds of nitrate per acre returned a profit of 206 per cent. on the cost of the fertilizer, while the heaviest application resulted in a net profit of 140 per cent. The three different amounts of nitrate of soda gave profits per acre of \$4.73 for the light application, \$6.19 for the 100-

pound application, and \$8.40 for the 200-pound application. Sixty to 100 pounds of nitrate of soda is recommended to be applied as a top dressing to oats in March.

No nitrogen need be purchased for oats, provided the oats be sown after a crop of cow peas, velvet beans, peanuts, or soy beans, all of which crops, whether only the stubble or the entire growth was plowed under for fertilizer, afforded an increase in the succeeding oat crop of from 6.2 to 33.6 bushels per acre. From 5 to 15 bushels increase in the succeeding oat crop is considered an average result of the use of the stubble or vines of leguminous crops employed as fertilizer.

#### THE OAT CROP OF ALABAMA.

Official estimates credit Alabama with only 197,787 acres of oats in 1904, as compared with 2,791,811 acres of corn. Is there any adequate reason why the farmers of Alabama should plant only one acre of oats for every fourteen acres of corn? For the ten-year period ending with 1904, the average yield of corn in Alabama was 12.7 bushels, and the average yield of oats was 13.9 bushels. Reducing both to pounds, we have a yield of 714 pounds of shelled corn and 445 pounds of threshed oats per acre.

The small production of oats per acre in Alabama would be a sufficient reason for the neglect of this crop were no improvement in yield practicable. However, it is a comparatively easy matter to double or treble this yield, and at very slight expense, as indicated in the experiments described in this bulletin.

In view of present and prospective agricultural conditions in Alabama there is urgent need for a very great extension of the area devoted to oats. A decreasing supply of labor calls for an increasing proportion of crops that, like oats, can be handled largely by machinery, and that require little labor per acre. The continual impoverishment of the soils of the Southern States argues for the more general in-

roduction of crops that will improve the soil. This improvement can be effected universally by the growing of cow peas, but most cotton farmers will not grow any considerable area of cow peas except on the land from which a crop of small grain has been harvested. Hence the extension of the culture of the small grains means an increase in the acreage of cow peas, soy beans, velvet beans, and peanuts, and hence the upbuilding of the soil.

#### YIELD OF OATS COMPARED WITH THAT OF CORN.

We have seen from a preceding paragraph that corn and oats average respectively in Alabama 714 and 445 pounds per acre. This comparison is scarcely fair to oats, for the reason that this crop is usually assigned to the poorest land on the farm, and is seldom fertilized. To ascertain the relative yields of oats and corn on adjacent plots, a careful study has been

made of the results of an unpublished rotation experiment that has been in progress on the station farm at Auburn during the past ten years. We are able to make a satisfactory comparison for three years when all conditions of fertilization, season, and time of sowing were normal or identical for the two crops.

The average yield of oats from fall sowing (October 16 being the average date of sowing) was 24.6 bushels per acre, as compared with 13.8 bushels of corn planted April 6 to 8 each year. No nitrate of soda was used.

Reducing both crops to pounds of grain per acre we have 787 pounds of threshed oats and 772 pounds of shelled corn. This indicates that the yields under these conditions were practically identical in the following rotation:

1st year: Cotton.

2nd year: Corn, with cow peas between the rows.

3rd year: Fall sown Red oats, followed by cow peas.

In this rotation corn has a slightly more favorable position than oats, but this is doubtless offset by the fact that



the fertilizer used was not the one which affords the largest yield of oats.

In one experiment in which oats were compared with other small grains, all sown in the fall, the yields were as follows:

*Oats versus wheat versus barley for hay and for grain in 1904.*

CROP.	Yield per acre,		
	Unthreshed.	Grain.	
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Bus.</i>
Alabama Blue Stem Wheat .....	2620	990	16.5
Red Rust Proof Oats ....	1950	1150	36.0
Bearded Barley.....	1400	600	12.5
Culberson Oats.....	1400	700	21.9

This shows a greater number of pounds of grain yielded by oats than by wheat or bearded barley. However, the weight of unthreshed grain and straw combined was greater with wheat, which indicates that wheat affords a larger yield of hay than does oats.

In a comparison of Red Rust Proof oats and Beardless barley both sown February 25, the yield of oats was 25 bushels (806 pounds) and of Beardless barley 18.7 bushels (880 pounds), the yield of barley being greater than we ordinarily secure.

#### VARIETIES.

While the list of varieties of oats grown in the Northern States and in Europe is a long one, there are but few kinds that thus far have proved suitable for the Gulf States. Our tests of varieties have been concerned almost entirely with the standard southern kinds, namely: Red Rust Proof, Apler, Culberson, Burt, and Turf or Winter Grazing oats. The first table that follows gives the yields of varieties sown in the fall. The average date of sowing has been November 14, which is too late for maximum yields, and especially much too late for the Turf oats. The next table gives the

yields resulting from sowing oats in February or March, the average date of these spring sowings being February 20, which is several weeks later than the date preferred by the writer for oats sown after Christmas.

The third table following is calculated from the other two and is the most important of the tables, giving the relative yields of varieties in terms of percentage and average results of experiments extending through a number of years.

*Tests of varieties of oats sown at Auburn in the fall.*

Variety	Per ct Grain	Yield per acre	
		Straw	Grain
<i>Sown Nov. 6, 1897</i>		<i>Lbs.</i>	<i>Bus.</i>
Red Rust Proof .....	41.3	1,800	30.8
Hatchett's Black .....	38.7	1,057	20.8
Beardless Red .....	42.9	1,155	27.1
Early Siberian .....	28.5	1,129	13.9
Gray Winter or Turf .....	29.6	1,232	16.1
Deleware Winter .....	30.4	783	10.6
<i>Sown Nov. 23, 1899.</i>			
Red Rust Poof .....	48.6	869	13.5
Gray Winter or Turf .....	31.2	769	7.5
Hatchett's Black .....	45.9	675	14.0
<i>Sown Nov. 13, 1903.</i>			
Red Rust Proof .....	32.6	1,320	30.0
Appler .....	37.8	1,720	32.7
Culberson .....	38.3	1,440	28.0
Gray Winter or (Va. Gray) .....	32.5	1,400	21.0
<i>Sown Nov. 10, 1904.</i>			
*Red Rust Proof(spring strain) .....	44.4	1,120	28.0
*Appler .....	52.0	836	28.3
*Culberson .....	45.1	1,144	29.4
<i>Sown Nov. 18, 1905.</i>			
Appier .....	48.9	2,080	52.6
Burt .....	37.4	2,784	52.0
Culberson .....	45.7	2,068	48.0
Red Rust Proof (fall strain) .....	47.7	1,974	48.4
<i>Sown Nov. 14, 1905.</i>			
Burt (av.fall and spring strains) .....	44.9	1,784	46.1
May .....	46.9	1,880	51.9
Red Rust Proof (av. fall and spring strains) .....	46.8	1,575	58.2

\*Partly winter killed.

*Tests of varieties of oats sown at Auburn in the spring.*

Variety.	Percent Grain.	YIELD PER ACRE	
		Straw	Grain
<i>Sown Feb. 17, 1898.</i>			
May .....	39.9	1,790	35.9
Burt .....	41.7	1,658	41.4
Gray Winter or Turf .....	20.0	690	5.5
Red Rust Proof .....	42.9	1,276	30.6
<i>Sown Mar. 7, 1902.</i>			
Burt .....	27.6	616	7.3
Culberson .....	43.1	620	14.7
May .....	47.1	370	10.3
Red Rust Proof .....	33.6	870	13.7
<i>Sown Feb. 5, 1903.</i>			
Burt .....	25.7	896	9.7
Culberson .....	34.3	557	9.1
May .....	40.9	605	13.1
Red Rust Proof .....	33.3	880	13.7
<i>Sown Feb. 23, 1905.</i>			
Red Rust Proof .....	42.1	1,384	31.5
May .....	36.4	1,929	35.0

*Relative yields of grain of varieties of oats at Auburn, taking yield of Red Rust Proof oats as 100.*

	1898	1900	1902	1903	1904	1905	1906	1907	Average
<i>Sown in November.</i>									
Red Rust Proof .....	100	100			100	100	100	100	100
Beardless Red .....	88				109	100	109		88
Appler .....					*93	106	100		106
Culberson .....									100
Early Siberian .....	45								45
Gray or Turf .....	52	56			70				59
Burt .....							108	78	93
May .....								81	81
Av. Burt and May .....									89
Hatchett's Black .....	68	104							86
Delaware Winter .....	31								31
<i>Sown in February.</i>									
Red Rust Proof .....	100		100	100		100			100
Burt .....	135		53	66					85
May .....	117		75	100		111			101
Av. Burt and May .....									93
Culberson .....			107	66					87
Gray or Turf .....	15								15

\*Yield reduced by smut.

\*\*Different fields and different dates of sowing.

The last table deserves careful study.

The variety Red Rust Proof, also known as Texas Rust Proof, Texas Red, and simply as Red oats, has in these tests, as usual, proved worthy of its position as the most popular or standard variety for the Gulf States. It has been relatively satisfactory whether sown in the spring or the fall, though fall sowing is decidedly preferable in the central and the southern parts of Alabama.

Appler, a selection from the Red Rust Proof, cannot be distinguished from its parent, but in the three tests made at Auburn, the Appler has afforded 6 per cent. more grain than the Red oat.

Culberson is also like Red oats in appearance of grain, and the yield when sown in the fall has averaged the same. With us it proved a little more hardy than the Red oat, a slightly larger proportion of the Culberson plants surviving the trying winter of 1904-5. It is apparently a strain of the Red Rust Proof variety. Both Culberson and Appler are at least equal in merit to the parent strain.

Winter Turf, also variously known as Gray Winter, Virginia Gray and Myers' Turf, has been relatively unproductive here, averaging only 59 per cent. as much grain as Red oats when sown as late as November 14, and apparently not equalling Red oats when sown at its proper season, September or October. Sown here in the spring, the Turf oat is an entire failure. It ripens about two weeks later than Red oats sown at the same date, and hence is especially liable to fail to fill out well, either because of rust or of drought. This oat is only to be considered for grazing or hay, or for grain on the very best land, or in those localities in the northern part of the cotton belt where Red oats are usually winter killed. It has been recommended as a good variety to sow for hay with hairy vetch, but this is only true on rich land, for on our poor sandy uplands at

Auburn, Turf oats do not throw up seed stems in time to support the slender vetch plants. Here we find that a beardless variety of wheat or the Red Rust Proof oat makes a more satisfactory combination with hairy vetch.

Burt and May are apparently the same variety, the latter being the local name near Auburn. This is a spring variety and is seldom sown in the fall; however, it passed without any winter killing whatsoever through the mild winter of 1905-6, and afforded an average yield of 89 per cent. as much grain as the Red oat. In the severe winter of 1904-5 only 5 or 10 per cent. of a stand survived from a sowing made November 10, 1904. When sown in the spring the grain yield of Burt or May oats averaged 93 per cent. of that of Red oats, some years the advantage being with one variety and some years with the other. It is generally believed that Burt can safely be sown later in the spring than Red oats, and while our sowing of March 7, 1902, does not support this opinion, yet the view seems reasonable and correct because of the quicker maturity and longer straw of the Burt.

#### DESCRIPTIONS OF STANDARD SOUTHERN VARIETIES OF OATS.

*Red Rust Proof*:—Plants medium height; straw large and strong; berries or "grain" bearded, beards borne on both grains in most spikelets; beards large and long, usually inserted low down on the larger grain, that is, half way between the base and the extreme tip, but nearer the tip on the small grain; color of berries yellowish-brown, darker near the base, and darkening on exposure to moisture. A characteristic of Red Rust Proof oats is the greater length of the slender bristles or hairs at the base of the spikelet (that is at the lower end of the larger grain), which bristles in other varieties commonly grown in the South are either wanting, or occur on only a few of the spikelets, or are shorter than on Red, Appler, and Culberson oats. The

grains are very large and very plump. This variety is sometimes attacked by rust, but is less injured by this disease than the other varieties tested.

*Appler*:—This is a selection from the Red Rust Proof oats, and most of the spikelets are not to be distinguished from the parent variety. As grown at Auburn in 1906 it was even less uniform than the Red, containing a large admixture of black grains and a considerable proportion of spikelets of which only the larger grain was bearded.

*Culberson*:—This appears to be a strain of Red oats. The straw is perhaps a little taller. The grains are strongly bearded, both grains being usually bearded. In color, size and plumpness the grain is not distinguishable from the Red oat. The bristles at the base of most spikelets are relatively long, as in Red oats.

All three of the above varieties, constituting the Red Rust Proof group, are decidedly mixed, or lacking in uniformity of grains, which indicates the need of breeding for pure strains, a work that this station now has in progress. In the Red Rust Proof group about half the weight of sheaf oats consists of straw and half of grain, though the proportion of straw exceeds this on rich land.

*Burt*:—The majority of spikelets bear one bearded and one beardless grain, but some are doubly bearded and a few entirely beardless. The grains are more slender than those of Red Rust Proof oats, of a paler cream or brownish-yellow color. Most spikelets have only short bristles, or none. The straw is taller and weaker than that of Red oats, and the date of ripening is earlier. This variety is tender and is adapted to spring sowing.

*Turf*:—This variety is beardless. The grains are slender, light cream or gray in color, of a lighter shade than Burt oats, and the two berries usually break apart in threshing. The percentage of grain is small, there being usually about twice as much straw as grain.

Since there are so few varieties of oats adapted to the Gulf States, it is important that some distinguishing marks be found by which Southern farmers may be able to identify seed oats of a few leading varieties. With this end in view careful examination has been made of the four most popular varieties in the South, and we have found what seems to be a means of positively distinguishing the seed of the Red Rust Proof group from the other well-known southern varieties. The greater plumpness of grain of the Red oats and the larger proportion of spikelets in which both grains are bearded will serve to separate the Red oat group. A still more positive indication that a sample of oats is the genuine Red Rust Proof is the presence of a bunch of fine hairs or bristles at the base of the lower grain and the *greater length* of some of these bristles in this variety than in other varieties in which bristles occur.

#### WINTER KILLING OF OATS.

Oat plants from sowings made in the fall are liable to be killed by cold weather at any date between December 1 and March 1 in the central part of Alabama. As illustrating the earliest and the latest dates on which severe winter killing has occurred within the memory and observation of the writer, I would say that March 1, 1890, was one of the coldest days of the winter, and oats growing on rich land, which had already thrown up tender seed stems, were entirely killed, while other plants at an earlier stage of growth were severely injured.

The earliest date recalled on which oats were injured was on December 15, 1901, when the temperature suddenly dropped below the freezing point, following a period of heavy rains. There were severe freezes at night and complete thawing during the day for nearly a week, thus affording extremely favorable conditions for the heaving and destruction of oat plants.

The lowest temperature ever recorded in Alabama, and

probably the most complete destruction of oats by cold was experienced in February, 1899, when on the station farm practically all Red oats were killed except near woods or protecting fences, where a part of a stand survived. That cold weather, during which the minimum temperature was  $-6$  Fahrenheit, not only killed Red oats, but Turf oats as well.

The following precautions used singly or together will greatly reduce the danger of winter killing and practically insure in this latitude the survival of a fair stand of oats, except in unusually severe winters:

(1) Sowing the seed in deep drills not completely covered, as discussed in a later paragraph.

(2) Sowing in October so as to give the plants time to form a strong root system as an anchor before severe freezes occur.

(3) Sowing with a grain drill, which leaves the land slightly ridged and the plants close together, thus apparently furnishing a small amount of mutual protection.

(4) Passing a roller over a field on which the plants have been heaved and the white roots exposed by alternate freezes and thaws.

(5) The sowing of Turf oats, which are hardier than Red oats, but are not to be preferred where the Red oats ordinarily succeed.

Cold weather may kill oat plants in either of two ways, directly by the action of the cold on the foliage and crown or indirectly by the heaving or lifting effects of alternate freezes and thaws. The first method of prevention mentioned above is effective against both results of cold, but is chiefly useful in preventing heaving. The use of the roller just after a succession of freezes is intended to counteract the results of heaving, since the roller presses the exposed crowns into contact with the soil, thus favoring the development of new roots. We have repeatedly used this method



with good results. It should, however, be remembered that the use of the roller while the land is still wet may result in unduly compacting the surface.

Before deciding whether it is best to rely chiefly on fall sown or on spring sown oats it is worth while to recall how many complete failures due to winter killing and how many partial killings have occurred within one or two decades in any given locality. Applying this test to the fall sown Red Rust proof oats on the Station farm at Auburn we find that during the past eleven years there has been but one winter in which practically all red oats have been killed, namely in 1899. In 1902 in spite of the trying weather of the preceding December, a part of the oats on the Experiment Station farm afforded a fair yield. The winter of 1904-5 was perhaps the third most unfavorable year as regards winter killing. Although the stand was very much thinned, yet the yields of our variety plots that year averaged about 28 bushels per acre. It is believed that farmers overestimate the danger of winter killing of oats or the frequency with which the stand is reduced to a point where the yield would be less than with oats sown in the spring. This tendency is natural, since few have put in effect the above-mentioned measures that may be taken to reduce the amount and frequency of winter killing.

#### TIME TO SOW OATS.

A large proportion of the oats grown in Alabama are sown in February. While this may perhaps be considered necessary for Red and Burt oats in those parts of the state in which experience indicates that fall sown oats are usually winter killed, yet this is the wrong time to sow most fields of Red oats in the central and southern parts of the State. Our experience, which is partly tabulated below, indicates that the yield from fall sowing is far greater than from sowing Red oats after Christmas. In all the experi-

ments tabulated below the same amount of fertilizer was used for the February sowing as for the November sowing, and all conditions were equal except the date of putting the seed into the ground.

*Average results of fall sown vs. spring sown oats.*

DATE OF SOWING	Percent grain in sheaf oats	Yield of grain per acre	Yield of straw per acre	Increase of grain from fall sowing
<i>Experiment No. 1.</i>	<i>Percent.</i>	<i>Bus.</i>	<i>Lbs.</i>	<i>Bus.</i>
November 18, 1896 .....	45	21.7	895	7.9
March 1, 1897 .....	43	13.8	587	
<i>Experiment No. 2.</i>				
November 23, 1897 .....	38	18.2	958	11.
February 9, 1898 .....	47	6.4	228	
<i>Experiment No. 3.</i>				
November 26, 1897 .....	43	23.8	994	9.7
February 9, 1898 .....	51	14.1	440	
<i>Experiment No. 4.</i>				
November 13, 1902 .....	40	27.2	1328	13.5
February 5, 1903 .....	34	13.7	1024	
<i>Experiment No. 5.</i>				
November 19, 1903 .....	57	15.9	384	2.6
February 23, 1904 .....	55	13.3	416	
<i>Experiment No. 6.</i>				
November 10, 1904 .....	44	*26.9	1068	—*5.1
February 23, 1905 .....	43	32.0	1360	
<i>Experiment No. 7.</i>				
November 14, 1905 .....	52	53.8	1560	38.8
February 16, 1906 .....	....	15.0	.....	
<b>Average 7 Experiments .....</b>				<b>11.3</b>

\*Fully 25 winter killed.

The average of seven experiments shows a gain of 11.3 bushels or 73 per cent from sowing Red oats in November as compared with sowing them in February. Who can afford such a loss? Who would not arrange to pay his notes three months ahead of maturity if thereby he could have 43 per cent deducted from their face? The two cases are arithmetically the same. If the "turning out" of cattle by common consent in winter prevents the sowing of grain in the fall, is the few months' winter range worth the sacrifice?

Other experience, often repeated, has shown us that the average date of fall sowing in the table above, November 17, is too late for maximum yields of fall sown oats. We have found that sowing in October gives a larger yield and the plants endure cold better than do plants from sowings made in November. I would recommend October sowing, while realizing that any date between September 1 and November 15 may afford satisfactory yields. We find it advisable to discontinue entirely the sowing of oats about the first of December. For such fields as must be sown after Christmas I prefer on the uplands in this latitude to sow about February 1. For oats sown after Christmas only the richest lands are suitable and these are needed for other crops. On the other hand, oats sown in the fall may make a profitable crop on land that is quite poor, provided they be judiciously fertilized. Thus the advantages of fall sowing consist of (1) a much larger yield, even after deducting the losses from partial winter killing; (2) the utilization of poorer land by the fall sown crop, (3) the employment of teams at a time when they are not needed in preparation of land for cotton or corn, and (4) earlier maturity of fall sown oats, permitting the use of the crop and the use of the land at least two weeks earlier than when oats are sown after Christmas.

#### METHODS OF SOWING OATS.

A method of sowing oats that has proved highly satisfactory as the most effective known means of avoiding winter killing consists in opening deep furrows at intervals of 18 to 24 inches and drilling the seed and fertilizer in the bottom of these furrows, barely covering the seed with such earth as falls in as the one-horse planter and fertilizer distributor passes along. The primary object is to reduce the amount of killing by placing the plants in a position where they will not be heaved by alternate freezes and thaws.

For four years we have compared this method with a modification of the same, in which the deep furrows were covered nearly or quite full after the sowing of the seed, and with broadcast sowing.

In 1900 a harrow was run over all plots and dragged in more dirt than was intended. That year the "covered" drills were filled and the oats covered by the use of scooters on a double stock. In 1899-1900 the drilled oats were scarcely injured by cold, while the broadcast plots lost about 25 per cent of their plants, and yielded far less grain than either method of drilling. In 1904 the broadcast plots lost about 20 per cent of their plants from winter killing, while the loss from cold in the drilled plots was insignilcant; some plants in the deep, partially filled furrows were injured by sand washing in.

In 1905 there was some loss from cold on all plots, this being estimated at 20 per cent on the broadcast plots, 10 per cent on the plots sown in filled furrows, and only 5 per cent in furrows only partially filled.

In the average results and in three out of four years drilling oats in furrows two feet apart yielded decidedly more than did the sowing of the seed broadcast on the plowed ground and covering with a disc harrow or other similar implement.

No very severe winter occurred while this test was in progress, which probably accounts for the practical equality in resistance to cold of the plants in the filled and in the partly filled furrows.

For well drained soils there are decided advantages in drilling fall sown oats in deep furrows, especially when the winter proves severe. It is advisable where practicable to run the rows perpendicular to the line of the coldest winds, which would give the rows a direction from southwest to northeast, or east and west.

This method of sowing oats in deep unfilled furrows is

evidently not adapted to prairie or other very stiff, poorly drained soil, where standing water in the furrows would drown the young plants, and it is slower than sowing broadcast or using a grain drill.

*Yields of oats sown broadcast and in deep furrows, or entirely drilled.*

Year	Yield per acre.			
	Broad-cast	8 in. drill	Deep furrow, slight covering	Deep furrow, covered
	<i>Bws.</i>		<i>Bws.</i>	<i>Bws.</i>
1900	19.9		24.3	29.1
1903	26.4		33.7	25.7
1904	16.0		19.2	20.5
1905	34.6	31.0	32.3	31.5
Average	24.2		27.4	26.7

#### INCREASING THE HARDINESS OF OATS.

In a severe winter the oat plants that survive the winter are either those best protected by their location or else those possessing in themselves a special degree of hardiness. If we could plant seed only from plants possessing this inherent hardiness we should doubtless be able within a few years to breed up a variety hardy enough to endure the severest winters. The Alabama Experiment Station has for several years been engaged in this attempt to increase the hardiness of our ordinary Red Rust Proof oats towards cold. Since we cannot separate those plants whose survival of winter's cold is merely accidental, or due to their environment, from those plants that have in themselves special hardiness, our task will doubtless take many years for its accomplishment. For though we select each year from plants that survived the previous winter and whose ancestors survived still earlier winters, yet among these continuously hardy plants are many tender plants that have endured the

could merely because of favorable environment. It will require the recurrence of several severe winters to eliminate all the tender plants.

In thus breeding the oat plant for improvement in hardiness we also had an opportunity to ascertain whether seed oats for sowing in the fall should come from a strain sown each year in the fall or indifferently from either fall or spring-sown ancestry. The following table presents the results of this inquiry to date.

*Yields of oats from sowing in the fall seed from fall-sown vs. spring-sown ancestry.*

Year	Variety	Date of sowing	Yield per acre			
			Fall strain		Spring strain	
			Straw	Grain	Straw	Grain
			Lbs.	Bus.	Lbs.	Bus.
1898	Red Rust Proof .....	Nov. 6	1050	25.3	996	28.6
1903	Red Rust Proof .....	Nov. 13	1110	21.3	505	11.3
1904	Red Rust Proof .....	Nov.	960	30.0	888	27.7
1905	Red Rust Proof (Broadcast)....	Nov. 5	1352	35.5	1160	33.7
1905	Red Rust Proof (8-in. drills)..	Nov. 5	1256	31.0	1128	31.0
1006	Red Rust Proof (8-in. drills)..	Nov. 18	1936	50.9	2112	51.0
1906	Red Rust Proof (8-in. drills)..	Nov. 14	1560	53.8	1590	62.5
1906	Burt .....	Nov. 14	1676	45.6	1892	46.5
	Average .....		1223	36.7	1283	36.5

Thus far the difference in yield is slight and accidental between a strain of oats that for several years has been continuously sown in the fall and other oats descended from crops alternately sown in fall and in spring. In the above table the fall strain of Red Rust Proof oats has been continuous, having been sown in the fall of 1902, 1903, 1904, 1905: in 1902 the fall sown seed were from the station farm where nearly all the oats are sown in the fall, and hence the habit of growing in winter extends back at least five years prior to 1902. The "spring strain" seed oats does not represent a continuously spring-sown ancestry, but usually only one generation of spring-sown oats. This experiment with Red

oats will be continued. Until we can accumulate conclusive data we can advise only on theoretical considerations. These suggest the probable advisability of sowing in the fall seed from a strain that for several years has been sown in the fall. This is another argument for saving one's own seed oats, for we seldom know whether purchased seed oats are accustomed to fall or to spring planting nor whether grown in or near this latitude.

#### PREVENTION OF SMUT.

Smut is almost universally present in the oat fields of Alabama, blackening many of the heads and reducing the yield from 5 to 30 per cent. It can be prevented easily and cheaply. Several methods may be used, the most convenient being the use of formalin. Unfortunately this useful material is not generally found in the smaller drug stores but may be ordered from wholesale drug stores through local druggists. The cost should not exceed one dollar per pound including express charges, and in large amounts the cost is much lower. Pour one ounce of this liquid formalin into three gallons of water. Into this liquid the oats may be dipped and then drained and spread out to dry, or the liquid may be sprinkled over the pile of oats until the grains are thoroughly moistened. Then the pile of treated seed should be kept covered from two to ten hours, so that the gas generated may destroy the germs or "seed" of smut, which are present on the oat kernel. One ounce of formalin will treat a number of bushels of oats, making the cost only a few cents per acre. The saving or increase in the crop will usually be from 8 to 20 per cent, or say 2 to 8 bushels per acre. We cannot afford to plant oats without this or equivalent treatment.

In case formalin is not quickly obtainable smut in oats may be destroyed by the following method: Obtain an accurate thermometer. A dairy thermometer costing 25 to

50 cents will usually answer. Then dip the bags of seed oats into hot water which must be kept at a temperature of about 132 degrees, not dropping below 130 nor running above 135 degrees Fahrenheit. Keep the oats in this hot water for ten or twelve minutes, stirring them so that every grain becomes heated. Then remove the sack of oats and dip into cold water. After this cooling the oats should be spread out to dry, never spreading them on a floor on which untreated seed oats have been stored.

#### FERTILIZERS FOR OATS.

It is a custom far too common in Alabama to sow oats without any fertilizer. The experiments here recorded show that it pays to fertilize oats, and that the most profitable fertilizer is one that is rich in nitrogen. Omitting the long table of figures, the conclusions drawn from average results of a number of years' experimentation in Auburn are here given. On our sandy and loam soils rather heavily fertilized with complete commercial fertilizers for a number of years, the results were briefly as follows: Potash was practically useless; acid phosphate was of secondary importance, while nitrogen in whatever form applied, whether as stable manure, cotton seed, cotton seed meal, or nitrate of soda, gave a considerable increase in the yield of oats.

#### BARNYARD MANURE AS A FERTILIZER FOR OATS.

For several years an experiment has been in progress to determine the increase in various crops due to the application of manure during the current or previous season. Only such of these data as bear on the oat crop are here given. In the winter of 1900 heavy applications of cattle manure, obtained by the use of a ration of cotton seed meal or of cotton seed, were applied to fall-sown oats. The following table shows the results obtained the first year, in which the



increase in yield was 29.6 or 31.5 bushels of oats per acre:

*Immediate or first year effect of cattle manure applied to oats.*

Manure per acre. <i>Lbs.</i>	Manure from feeding.	Yield per acre. <i>Bus.</i>	Increase per acre. <i>Bus.</i>
43740	C. S. Meal, etc.,	40.7	31.5
30600	Cotton Seed, etc.	38.8	29.6
No manure		9.2	

The next year oats were again grown on the same field without additional fertilizer.

Manure per acre previous year <i>Lbs.</i>	Yield per acre second year. <i>Bus.</i>	Increase per acre second year. <i>Bus.</i>
43740	37.5	26.
30600	28.	16.5

Even on this sandy soil a heavy application of stable manure gave a large increase in the second crop of oats, as well as in the crop to which it was directly applied. The important matter is to determine what increase in crop was afforded by each ton of manure, and this information is contained in the following table, which deals not only with this experiment, but with two others in which very light applications of horse manure were employed.

*Increase in first and second crops of oats per ton of manure.*

<i>Tons</i> Manure per acre	Kind of Manure	Increase per ton of manure.		
		First year oats	Second year Oats	Total 2 years Oats
		<i>Bus.</i>	<i>Bus.</i>	<i>Bus.</i>
21.87	Cattle; from feeding c. s. meal, etc.	1.4	1.2	2.6
15.3	Cattle; from feeding cotton seed, etc.	1.9	1.1	3.0
6.2	Cattle; from feeding c. s. meal, etc.	1.6	.5	2.1
2.°	Horse manure.....	8.8		
2.°	Horse manure .....	9.8		

From the above table it will be seen that where heavy applications of rich cattle manure were made to oats the aggregate increase in yield of the two following crops was 2.8 bushels per acre and that of this the second year's increase accounts for more than one bushel. On the other hand, when only two tons per acre of horse manure was used the increase the first year averaged 9.3 bushels per acre. This illustrates the greater efficiency per ton of the smaller applications, though the broadcast application of less than four tons per acre is scarcely practicable even by the use of the manure spreader. This expensive piece of farm machinery is needed where large amounts of manure are to be distributed, for it greatly reduces the amount of labor in handling manure, pulverizes the material finely, and enables a lighter application to be made where this is desired, the lighter application and the finer pulverizing making a given amount of manure go further and afford a larger increase in crop yield.

#### COTTON SEED VERSUS COTTON SEED MEAL.

In three experiments made in as many different years we have compared 200 pounds of cotton seed meal with 434 pounds of cotton seed, both furnishing equal amounts of nitrogen and both being applied at the time of planting in the fall. In every case cotton seed meal has given larger yields, the excess resulting from the use of meal as compared with seed being in different years respectively 2.1, .7 and 11.8 bushels of oats per acre, which would give an average advantage of 4.9 bushels per acre to the meal. If we reject the last figure as being so large as to excite suspicion of error we still have an average advantage of 1.4 bushels per acre in favor of the cotton seed meal.

While cotton seed has long been recognized as an excellent fertilizer for oats, especially when used in large amounts, the increased price of cotton seed and the superior effects of an equal value of nitrate of soda on oats

make it unadvisable to apply cotton seed to the oat crop if nitrate of soda can be purchased.

Since the fertilizer requirements of wheat and oats are presumably about the same, I would add that in similar experiments with wheat cotton seed meal gave a slightly larger yield than cotton seed, both used in the amounts mentioned above.

#### NITRATE OF SODA AS A FERTILIZER FOR OATS.

Numerous experiments made under the writer's direction both on sandy loam soil at Auburn and on stiff lime lands at Uniontown show that this is by far the most effective commercial fertilizer for oats. The following table affords means of comparing nitrate of soda with cotton seed meal, cotton seed, and stable manure, which are the principal sources of fertilizer nitrogen available to the southern farmer.

*Cotton seed meal, cotton seed, nitrate of soda, and manure as fertilizers for oats.*

Amount per acre.	FERTILIZER	Yield and increase per acre							Average increase per acre due to Nitrogen.
		1901			1906				
		Yield straw	Yield grain	Increase in grain due to Nitrate.	Yield straw	Yield grain	Nitrate due to	Increase	
Lbs.		Lbs.	Bus	Bus.	Lbs.	Bus	Bus.	Bus.	
{ 200	Cotton seed meal	827	24.9	8.0	1788	42.9	13.0	10.5	
{ 240	Acid Phosphate								
{ 434	Cotton Seed	774	24.2	7.3	1136	32.1	2.2	4.8	
{ 240	Acid Phosphate								
{ 240	Acid Phosphate	532	16.9	0.0	1160	29.9	0.		
{ 100	Nitrate of Soda <sup>(in spring)</sup>								
{ 240	Acid Phosphate	1130	36.3	19.4	1776	55.8	25.9	22.7	
{ 100	Nitrate of Soda <sup>(at planting)</sup>								
{ 240	Acid Phosphate	1222	36.0	19.1	2128	54.4	24.5	21.8	
{ 4000	Manure								
		1152	34.4	17.5	2152	51.5	21.6	19.6	

Referring to the figures in the preceding table, we have the following comparison between the results of 2 tons of

fine horse manure and an application of 100 pounds of nitrate of soda together with 240 pounds of acid phosphate, the phosphate being applied at time of sowing in the fall and the nitrate being applied as a top dressing in March.

With two tons of fine horse manure applied in the fall the average increase was 19.6 bushels of oats per acre; with the commercial fertilizer mixture the average increase was 22.7 bushels of oats. In other words equal first-year results were obtained from the use of one ton of manure as from 43.1 pounds of nitrate of soda aided by 103 pounds of acid phosphate. With nitrate at \$60 and phosphate at \$12.50 per ton these amounts of commercial fertilizer cost \$1.93. Hence the farmer could afford to invest at least this amount in the production or purchase and very thin distribution of one ton of fresh unleached horse manure, and still be ahead by the greater effect of manure than of chemicals after the first year. We have seen in a preceding paragraph that the second year effect of a ton of manure on our sandy loam soils is equivalent to more than one bushel of oats per acre.

While the application of stable manure to oats on poor land is to be commended, yet the limited supply of this material makes it necessary for the farmer to purchase nitrogen in commercial fertilizers. Probably even better use for manure can be made than to apply it on oats, thus making it necessary to purchase nitrate of soda for oats and other small grain.

The following table shows the results of 13 different experiments conducted under the writer's direction at Auburn and Uniontown, Ala., and bearing on the effects of nitrate of soda applied in March as a top dressing for oats:

Year	Date of sowing oats	Amt. of nitrate per acre	Date of applying nitrate	Yield per acre	Increase due to nitrate	
<i>Fall sown</i>		<i>Lbs.</i>		<i>Bus.</i>	<i>Bus.</i>	<i>Percent</i>
1904	Nov. 4,	200	March	49.5	32.3	188
*1903	Oct.	200	March	43.8	25.3	137
<b>Av.</b>		<b>200</b>		<b>46.7</b>	<b>28.8</b>	<b>163</b>
1906	Nov. 20	120	March 13	34.2	21.8	176
1901	Nov. 15	100	March 18	36.3	19.4	116
1906	Nov. 15	100	March 13	55.8	22.7	69
*1903	Oct.	100	March	34.0	14.8	77
*1904	Nov. 4	100	March	42.3	17.0	67
<b>Av.</b>		<b>100</b>		<b>42.1</b>	<b>18.5</b>	<b>82</b>
1896	Oct.	80	March 28	29.3	12.9	79
1906	Nov. 20	60	March 13	28.0	15.6	126
1904	Nov. 4	50	March	29.0	11.3	64
<b>Av.</b>		<b>63</b>		<b>28.78</b>	<b>13.3</b>	<b>90</b>
<i>Spring sown</i>						
1896	Jan. 27	120	March 28	20.3	9.9	95
*1903	March 19	80		29.0	8.0	38
1900	Feb. 20	76	March 25	19.7	7.4	60
<b>Av.</b>		<b>92</b>		<b>23.</b>	<b>8.4</b>	<b>64</b>

\*On stiff lime land at Uniontown; from Bul. 22, Ala., Canebrake Exp. Station, by J. F. Duggar and J. M. Richeson.

In the following table the preceding data are so arranged as to show average results from the use of different amounts of nitrate of soda on oats:

*Increase and profit from nitrate of soda and cost of fertilizer per bushel of increase.*

Nitrate of soda per acre	Inc'ase due to nitrate per acre	Profit per acre from nitrate	Inc'ase due to nitrate	Lbs nitrate per bushel of increase	Cost per bu. of increase	Year	Soil
<i>Lbs.</i>	<i>Bus.</i>	<i>\$</i>	<i>Per ct</i>	<i>Lbs.</i>	<i>\$</i>		
<i>Fall sown</i>							
200	32.3	10.15	188	6.2	0.186	1904	Lime
200	25.3	6.65	137	7.9	0.237	1903	Lime
<b>Av. 200</b>	<b>28.8</b>	<b>8.40</b>	<b>163</b>	<b>7.0</b>	<b>0.211</b>		
120	21.8	7.60	176	5.5	0.165	1906	Sandy loam
100	19.4	6.70	115	5.2	0.156	1901	Sandy loam
100	22.7	8.35	69	4.4	0.132	1906	Sandy loam
100	14.8	8.40	77	6.9	0.207	1903	Lime
100	17.0	4.50	67	7.1	0.213	1904	Lime
<b>Av. 100</b>	<b>18.5</b>	<b>6.19</b>	<b>82</b>	<b>5.9</b>	<b>0.177</b>		
80	12.9	4.05	79	6.2	0.186	1896	Sandy loam
60	15.6	6.00	126	3.9	0.117	1906	Sandy loam
50	11.3	4.15	64	4.4	0.132	1904	Lime
<b>Av: 50 to 80</b>	<b>13.3</b>	<b>4.73</b>	<b>90</b>	<b>4.8</b>	<b>0.145</b>		
<i>Spring S.</i>							
120	9.9	1.35	95	12.1	0.363	1896	Sandy loam
80	8.0	1.60	38	10.0	0.300	1903	Sandy loam
76	7.4	1.42	60	10.3	0.309	1900	Sandy loam
<b>Av. Sp. S.</b>	<b>8.4</b>	<b>1.45</b>	<b>64</b>	<b>10.8</b>	<b>0.324</b>		

In the above table the figures representing the averages are highly significant and worthy of careful study. They show that from 200 pounds of nitrate of soda the average increase was 28.8 bushels of oats per acre; from an applying 63 pounds of nitrate of soda, the increase was 13.3 bushels; and from the application of smaller amounts (averaging 63 pounds of nitrate of soda, the increase was 13.3 bushels of oats per acre. It is notable that when nitrate was applied to spring sown oats the results were less favorable than when used on fall sown oats, the application of an average of 92 pounds of nitrate on spring-sown oats giving an

increase of only 8.4 bushels. The percentages of increased yield were respectively 163, 82, 90, and 64.

The fifth column of the table shows the number of pounds of nitrate of soda required per bushel of increase of yield, namely 7.1 pounds where 200 pounds per acre was employed, 5.9 pounds where the application was 100 pounds of nitrate of soda, and 4.8 pounds when an average of only 63 pounds of nitrate of soda per acre was used on fall sown oats. These figures again show the greater relative efficiency of the smaller applications. Notice again that it takes more fertilizer to add a bushel to the crop in the case of spring sown oats, namely, 10.8 pounds of nitrate of soda per bushel of increase, or nearly twice the fertilizer necessary to the same results on fall sown oats. The average cost of nitrate of soda to make one bushel of increase was 21.1 cents for the very heavy application; 17.7 cents when 100 pounds of nitrate of soda was applied, and only 14.5 cents when a very light application was made to fall-sown oats. When, however, a light application of nitrate was made to spring-sown oats each bushel of increase cost for nitrate of soda, 32.4 cents, a further proof of the greater profit from fall sown oats. If we will think of oats as worth 50 cents per bushel we will notice that after deducting the cost of the fertilizer, each bushel of increase made by fall-sown oats and due to nitrate of soda afforded a profit of from 28.9 cents to 35.5 cents, the greater profit per bushel being obtained from the smaller applications.

After all, profit is the important consideration, therefore, let us examine the financial returns per acre from the use of nitrate of soda. After deducting the cost of nitrate of soda at the rate of \$60.00 per ton we have left a profit of \$8.40 from an application of 200 pounds per acre; a profit of \$6.19 from an application of 100 pounds; and a profit of \$4.73 from a light application, averaging 63 pounds of

nitrate of soda per acre. Surely farmers cannot afford to withhold this fertilizer when profits like these can be had by its judicious use.

These facts appear in still more striking form when we figure the percentage of profit on the amount invested in nitrate of soda. When this fertilizer was used at the rate of 200 pounds per acre the profit on the fertilizer investment was 140 per cent; 206 percent when the fertilizer was used at the rate of 100 pounds per acre; and 249 percent when a lighter application was made on fall-sown oats. These last figures illustrate the general tendency of fertilizers to return the largest percent on the investment in fertilizers when used in small amounts. But this alone should not govern, for preceding figures have shown that heavier applications afford a greater aggregate profit per acre, and hence are advisable for the farmer who has abundant capital to invest in fertilizers.

I recommend that nitrate of soda be used at the rate of from 60 to 100 pounds per acre, according to the amount that the farmer can afford to invest in fertilizers. From such an investment he should expect to realize a profit of \$4.00 to \$6.00, provided the application be made to fall sown oats. If the nitrate be used on spring sown oats the profit may be only about half of the above figures, but even here fertilization with nitrate of soda is advisable.

#### WHEN TO APPLY NITRATE OF SODA.

The experiments conducted in Auburn, and recorded in Bulletin No. 95 of this Station, indicate that nitrate of soda should be applied early enough to give at least 55 days before the time of application and the probable date of harvesting the grain. Any time in March is suitable. We have found nitrate of soda applied as a top dressing in March more effective with oats and wheat than when put into the ground with the seed in the fall. This superiority of the spring application has been greater with wheat than



with oats and much greater on quite sandy soil than on gravelly soil containing considerable clay, on which stiffer soil both fall and spring applications have greatly increased the yield of oats.

All lumps in the nitrate of soda must be carefully pulverized. The fertilizer is strewn by hand, and distributed as evenly as seed oats or seed wheat would be. No covering or harrowing is necessary. This fertilizer is so readily soluble that a small amount of moisture in the soil will dissolve it and carry it downward to the plant roots. It is best to sow nitrate of soda when the ground is somewhat moist, but one should avoid applying it just before a rain, which might wash away a large part of the nitrogen. Hence if practicable we prefer to apply nitrate of soda just as the weather clears after a period of rainy weather. We usually apply this fertilizer to oats about the middle of March, though application at any date within that month is satisfactory.

#### LEGUMINOUS PLANTS AS FERTILIZERS FOR OATS.

*Cowpea or velvet bean stubble or entire growth as fertilizers.* We have seen that of the commercial fertilizers the one best adapted to oats is nitrate of soda, but since the use of this material involves a cash expenditure, we may well inquire whether some fertilizing material produced on the farm may not act as a substitute. The principal materials that might thus be used are barnyard manure, which has already been discussed, and leguminous plants, such as cowpeas, soy beans, velvet beans, etc. Both the entire plant and the roots and stubble alone of these legumes are rich in nitrogen and hence useful as nitrogenous fertilizers. The following table, quoted from Bulletin No. 95 of this Station, gives the result of an experiment in which the use of either the stubble or entire plant of cow peas or velvet beans afforded an enormous increase in the yield of the

succeeding crop of oats, an increase larger than we can usually count on. The Red Rust Proof oats were sown in the fall of 1897 and the crop was cut May 18 following.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

*Yield per acre of oats grown after stubble or vines of cowpeas, velvet beans, etc.*

Plot No.		Yield per acre	
		Grain	Straw
		<i>Bus.</i>	<i>Lbs.</i>
1	Oats after velvet bean vines .....	28.6	1206
6	Oats after velvet bean stubble.....	38.7	1672
	Average after velvet bean vines and stubble	<b>33.6</b>	<b>1439</b>
4	Oats after cowpea vines .....	28.8	1463
3	Oats after cowpea stubble .....	34.4	2013
	Average after cowpea vines and stubble...	<b>31.6</b>	<b>1738</b>
2	Oats after crab grass and weeds .....	7.1	231
5	Oats after German millet.....	9.7	361
	Average, after non-leguminous plants. ....	<b>8.4</b>	<b>296</b>

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble or vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass.

May 18, 1898, oats on all plots were cut.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab-grass, weeds and German millet).

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous

or soil improving plants, instead of non-leguminous plants during the preceding season.

Undoubtedly this is an extreme, and not an average, case.

An unexpected result of this experiment is the larger crop on the plots where only the stubble was left than on those where the vines of cowpeas and velvet beans were plowed under. The writer thinks that the difference in yield was almost wholly due (1) to the fact that the vines (especially those of the velvet beans) were not properly buried by the small plow employed, and (2) that the seed bed for oats was more compact where only stubble was plowed under, a point of advantage, doubtless, in such a dry winter as that of 1897-'8. In Bulletin No. 120, of this station, we have shown that the residual fertilizing effect of the entire growth of legumes is greater than that of vines and stubble. For example, the average increase in the second crop after plowing under *stubble* of velvet beans and cowpeas averaged 12 per cent. while the increase of the second crop was 24 to 54 per cent where the *entire growth* of legumes was plowed under.

When spring sown oats follow leguminous plants the increase due to the legume is smaller than is indicated above. For example, in one of our experiments the yield of spring sown oats following German millet was 12.4 bushels per acre, while on an adjacent plot where cow pea vines had been plowed under the yield was 22.8 bushels. This gives an increase of 10.4 bushels per acre, worth \$5.20, as the fertilizing effect of a crop of cow pea vines of which the pods had been previously picked, yielding 11 bushels of cowpeas per acre. Thus the total value of the cow pea crop was about \$16 in addition to any fertilizing effect that may have extended to the second crop.

*Cowpeas, peanuts and soy beans as fertilizers for oats.*

The following table shows the yield of oats in 1906 on one of the poorest tracts of land on the station farm, which

would be classed as a poor grade of Norfolk sandy loam. It is a deep sandy soil, light gray in color. The table shows the yields of unfertilized oats when grown after each of the following crops: Sorghum, sweet potatoes, soy beans, chufas, corn, Whippoorwill cow peas, Spanish peanuts, and running peanuts.

*Effects of preceding crop on yield of fall sown oats in 1906.*

Preceding crop	Part plowed under	Oats per acre	
		Yield	Increase compared with oats after corn
Sorghum, drilled.....	Stubble.....	Bus. 12.4	Bus. —1.3
Sweet potatoes.....	Vines .....	12.4	—1.3
Chufas .....	Tops only.....	11.7	—2.0
Corn.....	Stubble.....	13.7	
Whippoorwill cowpeas (drilled, picked).....	Vines after picking....	19.9	6.2
Spanish peanuts .....	Shed leaves, etc.....	26.7	13.0
Running peanuts.....	All except nuts .....	30.0	16.3
Soy beans, drilled .....	Stubble.....	21.4	7.7
Soy beans, drilled.....	Entire growth .....	42.2	28.5
Sorghum; 60 lbs. nitrate of soda	Stubble.....		
Sorghum; 120 lbs. nitrate of soda	on oats.	28.0	14.3
	Stubble.....		
	on oats.	34.2	20.5

From this table we learn that a preceding crop of drilled Whippoorwill cow peas plowed under after the pods were picked and removed (yielding 17.5 bushels of cowpeas per acre), increased the crop of oats 6.2 bushels per acre as compared with the preceding crop of corn. This makes the crop of drilled cowpeas worth for seed and fertilizer at least \$20.00 per acre. Where peanuts were grown the increase was 13 to 16.3 bushels per acre; when soy beans, sown in drills, were cut and used for hay the remaining stubble increased the following oat crop 7.7 bushels per acre. When the entire crop of soy beans was plowed under the increase was 28.5 bushels.

It is interesting to notice that so far as measured by the first crop of oats 60 pounds of nitrate of soda was worth more than the stubble of soy beans or the picked vines of cow peas and worth nearly as much as the picked vines of running peanuts; 120 pounds of nitrate of soda gave a larger immediate result than any of the leguminous plants except soy beans where the entire growth was plowed under.

From all the experiments detailed above and from others it seems safe for a farmer by growing a crop of cowpeas before oats, to expect to increase the yield of oats by from 5 to 15 bushels or more per acre, whether the peas are simply picked or cut for hay.

In another experiment oats constituted the second crop after the plowing under of the picked vines of drilled cowpeas on a good grade of reddish loam soil, with retentive sub-soil. The increased yield on plots where cowpeas had grown two years before was 9.75 bushels of oats per acre, as compared with adjacent plots on which cotton had grown continuously for several years.

#### OATS AS A HAY CROP.

Good hay is made from oats cut when in the early dough stage.

On deep, gray, sandy soil (Norfolk sandy loam) two plots of Hatchett's Black oats were sown October 24. Both were fertilized at the time of sowing with 360 pounds of acid phosphate and 48 pounds of muriate of potash. The plots receiving no nitrogen yielded 678 pounds of cured hay per acre. The plots fertilized March 20 with 80 pounds of nitrate of soda per acre yielded 2,120 pounds of hay, or about 3 1-2 times as much as the plots without the nitrogen. From this late variety of oats the hay was ready to cut May 15. With Red oats the date for cutting oat hay is usually earlier.

#### PLACE OF OATS IN THE ROTATION ON THE COTTON FARM.

The small acreage devoted to oats on most cotton farms makes this crop a negligible factor in the farm rotation. Un-

doubtedly as the supply of labor decreases and the presence of the boll weevil makes it necessary to reduce the acreage and to intensify the fertilization and cultivation of cotton, oats will be grown on a more extensive scale. Even under present conditions it will be profitable to greatly extend the acreage in oats. Among the arguments for this increase is the fact that farmers seldom reserve any large acreage for cow peas except the land occupied during the earlier part of the year by a crop of small grain. More oats means more cow peas and more cow peas means a larger crop of cotton on this land the following and succeeding years. A desirable rotation for a cotton farm on which it is considered necessary to devote half of the land to cotton is the following:

1st year: Corn, with cow peas between the rows.

2nd year: Oats, followed by cowpeas, which may be cut for hay, picked, or grazed, or simply plowed under in December, January, or February, as fertilizer for the succeeding crop of cotton.

3rd year: Cotton.

4th year: Cotton.

A still more rapid improvement of the land would result from sowing crimson clover, properly inoculated, or other suitable winter growing leguminous plant in September among the growing cotton plants, covering with a one-horse harrow used just after the first or second picking, when little or no injury would be done to the cotton.

On a farm where stock is kept and where cotton requires only one-third of the cultivated area the rotation would be that given above for the first, second and third years, that is, corn, with cow peas; then oats, followed by cow peas; then cotton, and the fourth year corn again.

#### HOME GROWN SEED OATS.

While this Station has made no experiments comparing southern seed oats with those grown further north or west,

our experience shows that oats grown continuously for a number of years in Alabama do not "run out."

We use our own seed of Red Rust Proof oats year after year and our average yield in recent years has been greater than it was ten years ago. On farms where fair crops of oats are grown it is far better to save one's own seed than to buy seed of unknown origin, which may contain Johnson grass or other seed, and which may be otherwise objectionable.

Acknowledgements are hereby made to the following parties who at various times have participated in the conduct of the experiments herein recorded.

T. U. Culver, formerly Superintendent of the Farm; C. M. Floyd, Superintendent of the Farm during the past three years; and L. N. Duncan, Assistant in Agriculture, who has aided in the preparation of the tables in this bulletin.



FIG 1.—*Burt oats, April 23, 1906; right sown in November; left sown in February.*







**FIG. 3 .—***Burt oats, May 10, 1906; left sown in November;  
right sown in February.*



**FIG. 4.—***Red oats, May 10, 1906; left sown in November;  
right sown in February.*



**FIG. 5.**—*Red oats, May 29; right sown in November; left in February.*



**FIG. 6.**—*Red oats, April 23; fall sown; spring strain on left; fall strain on right.*



**FIG. 7.**—*Culberson on left, Turf on right, April 24; stakes 2 ft. high.*



**FIG 8.**—*Red oats on left, Turf oats on right, May 29, 1906.*



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**A L A B A M A**  
**Agricultural Experiment Station**

**OF THE**

**Alabama Polytechnic Institute,**

**A U B U R N .**

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**VARIETY TESTS WITH COTTON AND CORN.**  
**Williamson Method of Corn Culture.**

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**By**

**J. F. DUGGAR, Director**

**AND**

**L. N. DUNCAN, Assistant in Agriculture.**

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# VARIETY TESTS OF COTTON

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BY J. F. DUGGAR, DIRECTOR AND AGRICULTURIST

AND

L. N. DUNCAN, ASSISTANT IN AGRICULTURE.

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In order that the results of our unpublished variety tests of cotton may be in the hands of farmers in ample time for use in making plans for another year, this brief bulletin is presented. The results of other experiments made in 1905 and 1906 with cotton and corn will be reserved for future publications.

In addition to the varieties of cotton grown in plots of sufficient size to give an accurate measure of the yield per acre, a much larger collection of varieties has been grown, each on a small area, with a view to making descriptions of all obtainable varieties. We expect to publish a bulletin containing all these descriptions early next spring.

The two tables that follow give the yields in plot tests with 32 varieties of cotton in 1905 and with 20 varieties in 1906.

They were grown on ordinary upland. The soil where this test was made in 1905 was a stoney, reddish-gray sandy loam and the soil where varieties of cotton grew in 1906 was a gray sandy loam free from stones.

*Fields of lint and seed and total value per acre of varieties  
of cotton in 1905.*

Rank	VARIETY	Yield lint per acre	Yield seed per acre	Total value per acre*
		<i>Lbs.</i>	<i>Lbs.</i>	
1.	Toole .....	531.2	851.2	\$67.04
2.	Cook's Improved .....	528.0	828.8	66.53
3.	Cleveland .....	520.0	840.0	65.63
4.	Bancroft's Herlong .....	488.0	948.8	61.76
5.	Christopher .....	480.0	916.8	61.62
6.	Schley .....	480.0	880.0	61.36
7.	Rowden .....	480.0	868.8	61.23
8.	Pullnot .....	480.0	768.0	60.58
9.	Layton .....	480.0	756.0	60.49
10.	Russell .....	464.0	896.0	59.62
11.	Strickland .....	459.2	902.4	59.12
12.	Willett's Red Leaf .....	452.8	792.0	57.61
13.	Crossland .....	456.0	723.2	57.50
14.	Hawkins .....	456.0	688.0	57.26
15.	Alex. Allen .....	440.0	832.0	56.42
16.	Culpepper (av. 5 plots) ....	433.6	812.5	55.55
17.	Haggaman .....	432.0	776.0	55.11
18.	Peterkin .....	432.0	688.0	54.50
19.	Texas Bur .....	424.0	806.4	54.40
20.	Southern Wonder .....	420.8	819.2	54.11
21.	Blue Ribbon .....	416.0	916.8	54.06
22.	Cameron .....	424.0	736.0	53.91
23.	Truitt .....	416.0	768.0	53.22
24.	Woodfin's Prolific .....	404.8	800.0	52.15
25.	Jackson's Limbless .....	411.2	691.2	52.13
26.	King No. 1 .....	408.0	696.0	51.79
27.	Shine .....	400.0	792.0	51.54
28.	No. 148 (U. S. D. A. Selec.)	400.0	772.8	51.41
29.	Berry's Big Boll .....	392.0	824.0	50.85
30.	Welborn's Pet .....	376.0	680.0	48.00
31.	Rogers .....	324.0	611.2	41.54
32.	Dickson† .....	160.0	320.0	20.64

\*Lint at 11 1-2c; seed at 70c.

†Ruined by boll rot.

The fertilizer used consisted of the following ingredients and amounts per acre, all applied before planting:

1905.	1906.
80 lbs. Nitrate of soda .....	80 lbs.
160 lbs. Cotton seed meal .....	80 lbs.
240 lbs. Acid phosphate (14 per ct. available) .....	200 lbs.
64 lbs. Muriate of potash .....	48 lbs.
<hr/> 544 lbs.	<hr/> 408 lbs.

The crop was injured by excessive shedding late in the summer of 1906, and by a severe wind and rain storm in September, 1906, which considerably reduced the yield.

*Yields of lint and seed and total value per acre of varieties of cotton in 1906.*

Rank	VARIETY	Yield lint per acre	Yield seed per acre	Total value per acre*
		<i>Lbs.</i>	<i>Lbs.</i>	
1.	Cook's Improved .....	617.6	1076.8	\$69.30
2.	Cleveland .....	608.0	1184.0	69.09
3.	Layton .....	612.8	1072.0	68.78
4.	Toole .....	608.0	1048.0	68.14
5.	Pullnot .....	596.8	1124.8	67.55
6.	King No. 1 .....	592.0	1136.0	67.15
7.	Peterkin .....	588.8	1076.8	66.42
8.	Hawkins .....	552.0	1088.0	62.82
9.	Alex. Allen .....	536.0	1072.0	61.10
10.	Pride of Georgia .....	516.8	1200.0	60.08
11.	Willett's Red Leaf .....	512.0	976.0	58.03
12.	Christopher .....	504.0	1008.0	57.46
13.	Culpepper .....	503.3	1069.0	57.02
14.	Russell (U. S. D. A. Selec.)	488.0	1048.0	56.14
15.	Sunflower .....	472.0	1184.0	55.49
16.	Truitt .....	480.0	1008.0	55.06
17.	Russell (Ala.) .....	472.0	1016.0	54.31
18.	Floradora .....	460.8	1108.8	53.84
19.	Bancroft's Herlong .....	440.0	908.8	50.36
20.	No. 148 (U. S. D. A. selec.)	390.4	852.8	45.01

\*Lint at 10c per pound and seed at 70c per 100 pounds.

The tables show that in total value of lint and seed the five leading varieties were in order in 1905, Toole, Cook's Improved, Cleveland, Bancroft's Herlong, and Christopher, and in 1906, Cook's Improved, Cleveland, Layton, Toole and Pullnot.

Sunflower and Floradora are long staple varieties and such staples commanded in Opelika in the fall of 1906 a premium of about four cents per pound.

By assigning a price of 14 cents per pound to these long staples, the total value of their lint and seed becomes respectively \$74.37 and \$72.27. However, the land on which



these two varieties and Willett's Red Leaf grew is slightly lower and richer than that occupied by other varieties, so that even at a premium of four cents per pound it is not certain that the long staples head the list in total value of product. The bolls of these two long staple varieties being small picking is more difficult than with big boll varieties like Cook's Improved and Cleveland.

The Experiment Station has no seed for sale or distribution. Hence we give below the addresses of the parties from whom our seed was obtained:

Variety.	Seed from.
Alex. Allen .....	A. W. Allen, Temple, Ga.
Bancroft's Herlong ..	Edward Bancroft, Athens, Ga.
Berry's Big Boll .....	Harvey Seed Co., Montgomery, Ala.
Blue Ribbon .....	South Carolina Experiment Station, Clemson College, S. C.
Cameron .....	R. R. Cameron, West Green, Ala.
Christopher .....	R. H. Christopher, LaGrange, Ga.
Cleveland .....	J. R. Cleveland, Decatur, Miss.
Cook's Improved .....	J. R. Cook, Schley, Ga.
Crossland .....	U. S. Dept. of Agriculture, Washington, D. C.
Culpepper .....	J. E. Culpepper, Luthersville, Ga.
Dickson .....	Capers Dickson, Oxford, Ala.
Floradora .....	R. D. Tatum, Palmetto, Ga.
Haggaman .....	U. S. Dept. of Agriculture, Washington, D. C.
Hawkins .....	B. W. Hawkins, Nona, Ga.
Jackson's Limbless ..	Harvey Seed Co., Montgomery, Ala.
King No. 1 .....	T. J. King Co., Richmond, Va.
Layton .....	R. D. Layton, Cresston, S. C.
No. 148 (U. S. D. A.)	U. S. Dept. of Agriculture, Washington, D. C.
Peterkin .....	J. A. Peterkin, Ft. Motte, S. C.
Pride of Georgia .....	U. S. Dept. of Agriculture, Washington.
Pullnot .....	J. E. Bradbury, Athens, Ga.
Rodgers .....	R. H. Rodgers, Darlington, S. C.
Rowden .....	J. A. Shine, Falsion, N. C.
Russell .....	James Moore, Auburn, Ala.
Russell (U. S. D. A.)	U. S. Dept. of Agriculture, Washington.
Schley .....	R. D. Tatum, Palmetto, Ga.
Shine .....	J. A. Shine, Falsion, N. C.
Southern Wonder ....	L. F. Grier, Oxford, Ala.
Strickland .....	U. S. Dept. of Agriculture, Washington, D. C.
Sunflower .....	M. Schaefer, Yazoo City, Miss.
Texas Bur .....	C. E. Smith, Locust Grove, Ga.
Toole .....	W. W. Toole, Augusta, Ga.
Truitt .....	G. W. Truitt, LaGrange, Ga.
Welborn's Pet .....	N. L. Willett Drug Co., Augusta, Ga.
Willett's Red Leaf ...	N. L. Willett Drug Co., Augusta, Ga.
Woodfin's Prolific ....	S. V. Woodfin, Marion, Ala.

#### TEST OF VARIETIES OF CORN.

All tests of varieties of corn except that made in 1906

were published in Alabama Experiment Station Bulletin No. 134, issued in December, 1905. The results of the experiment made in 1906 are given below.

*Yield of shelled corn per acre in 1906.*

Rank	VARIETY.	Per cent stand.	Yield per acre.
		<i>Per ct.</i>	<i>Bus.</i>
1.	Sanders .....	97	28.9
2.	Marlboro .....	97	28.3
3.	Mosby .....	93	26.0
4.	Henry Grady .....	97	25.7
5.	Local White Cob .....	97	25.4
6.	Albemarle .....	96	25.1
7.	Experiment Station Yellow .....	97	24.7
8.	McMackin's Gourd Seed .....	96	24.4
9.	Cocke's Prolific .....	97	24.3
10.	Boone County Special .....	97	24.0
11.	Boone County White (Tenn.) .....	97	23.7
11.	Boone County White (Ind.) .....	97	23.7
12.	No. 77 U. S. D. A. Selection .....	97	23.4
13.	Henry Grady (white cob select) .....	97	23.1
14.	Red Corn .....	97	22.3
15.	Hickory King .....	97	22.0
16.	Leaming .....	97	18.6
16.	Reid's Yellow Dent .....	97	18.6
17.	Silver Mine (Iowa) .....	97	17.9
18.	Riley's Favorite .....	97	15.7

The best yields were made by Sanders, Marlboro, Mosby and Henry Grady, all except the latter being prolific or several-eared varieties. Sanders, Mosby, and Henry Grady are the varieties which in previous experiments made here have taken high rank. The early northern varieties are again shown to be worthless for Alabama conditions, the yield being low and the grain of very inferior quality.

The fertilizer used per acre consisted of

80 lbs. Nitrate of soda.  
 80 lbs. Cotton seed meal.  
 240 lbs. Acid phosphate.  
 40 lbs. Muriate of potash.

440 lbs. Total

The soil was a reddish-gray, stony, sandy loam, and this

upland field was the same on which the test of varieties of cotton was made in 1905.

We obtained seed of Albermarle from J. E. Stone, Sylacauga, Ala.; Henry Grady from W. J. Headden, Austelle, Ga.; Experiment Station Yellow from Ala. Expt. Sta., Auburn, Ala.

Seed of other varieties except the local white cob and Experiment Station Yellow were furnished by the U. S. Dept. of Agriculture, Washington, D. C., the early varieties having been grown in the North.

#### WILLIAMSON METHOD OF CORN CULTURE.

The press of the southern states has given much space during the past year or two to a discussion of a method of corn culture successfully practiced and ably advocated by Mr. McIver Williamson, of Darlington, S. C.

The distinctive features of this method are as follows:

(1) Dwarfing the corn plant by withholding fertilizers until the plant is several feet high and by omitting all cultivation from the time the plant is about eight inches high until it is about eighteen inches high.

(2) Thick planting in the row, which is made possible by the small size of the plants.

(3) Use of the turn plow in the last cultivations.

(4) Planting on land enriched by plowing under the entire growth of cowpeas.

To determine whether the dwarfing of plants and thicker planting have a favorable effect on the yield of corn two plots of poor gray sandy upland soil on the Experiment Station farm at Auburn were prepared alike and in accordance with Mr. Williamson's plan, the details being as follows: A fair growth of velvet bean vines was plowed under on both plots with a two-horse plow in February. Then rows were laid off 6 feet apart and bedded out, the water furrow thus formed being subsoiled, by using a Dixie turn plow with wing removed. Then with the same plow a slight list was formed in the water furrow. This list was

opened and corn planted and covered on both plots without fertilizer, planting it thick on the Williamson plot and about half as thick on the check plot. Unfortunately we were not able to plant this experiment early, as is recommended. The first and last cultivations of the two plots were similar. Fertilization of both plots was identical, namely the very heavy application, as advised for the Williamson method, of 200 pounds of cotton seed meal, 200 pounds of acid phosphate and 400 pounds kainit per acre applied to both plots June 23; and 200 pounds nitrate of soda applied to both plots in side furrows July 7.

The details of cultivation were as follows:

Williamson plot.	Check plot.
April 19 planted. ....	Planted.
May. Middles cultivated shallow.	Middles cultivated shallow.
May 21 .....	Two trips to row with Diverse Cultivator.
June 1 .....	Hoed and thinned to 1 plant every 33 inches.
June 7 .....	Cultivated with scooter and scrape 5 furrows per row.
June 21. Hoed and thinned to 1 plant every 16 inches.	.....
June 23. Two side furrows with scooter and scrape.	Two side furrows with scooter and scrape.
June 23. Applied 800 pounds complete fertilizer per acre in side furrows.	Applied 800 pounds complete fertilizer per acre in side furrows.
June 23. Finished cultivating middles deep with Dixie turn plow.	Finished cultivating middles with scooter and scrape.
July 7. Cultivated with scooter and scrape, plowing in cowpeas.	Cultivated with scooter and scrape, plowing in cowpeas.
July 7. Applied in both side furrows 200 pounds nitrate of soda per acre.	Applied in both side furrows 200 pounds nitrate of soda per acre.

A study of the statements above will show that the treatment of the two plots was identical except in the following points:

- (1) Later hoeing of the Williamson plot.
- (2) Double thickness of planting on the Williamson plot.
- (3) Omission of two cultivations on the Williamson

plot, namely, those given to the check plot on May 21 and June 7.

(4) Use of turn plow on the Williamson plot in cultivating middles on June 23.

The result of the thicker planting and the omission of cultivation between the early part of May and June 23 resulted in dwarfing the plants on the Williamson plot, which is the end aimed at in that system of culture. Its advocates claim that the dwarfing of the plant tends to promote the production of grain.

The yield of shelled corn was 30.5 bushels per acre on the Williamson plot and 29.5 bushels per acre on the check plot. This is a gain of one bushel per acre, or 3.4 per cent in favor of the Williamson method.

On the Williamson plot each plant averaged only about one-third (.346) of a pound of shelled corn; on the check plot the yield of grain per plant was almost exactly double this (.667 of a pound).

The ears were slightly larger on the check plot where the plants had greater distance, the average weight of shucked ear or nubbin being .54 of a pound as compared with an average weight of .45 of a pound on the Williamson plot. The variety used was Cocke's Prolific.

Naturally the plants with wider spacing on the check plots afforded a greater number of ears per plant, one hundred plants on the Williamson plot affording only 96 ears and nubbins as compared with 156 ears and nubbins per 100 plants on the check plot.

The average height from ground to the joint or node from which the ear or lower ear grew was 44 1-2 inches on the check plot and only 36 1-4 inches on the Williamson plot. The stalks on the Williamson plot were much more slender and broke down worse, the broken-over plants on the Williamson plot constituting 29 per cent, and on the check plot 14 per cent. This means a greater tendency for the corn to rot in the field on the Williamson plot.

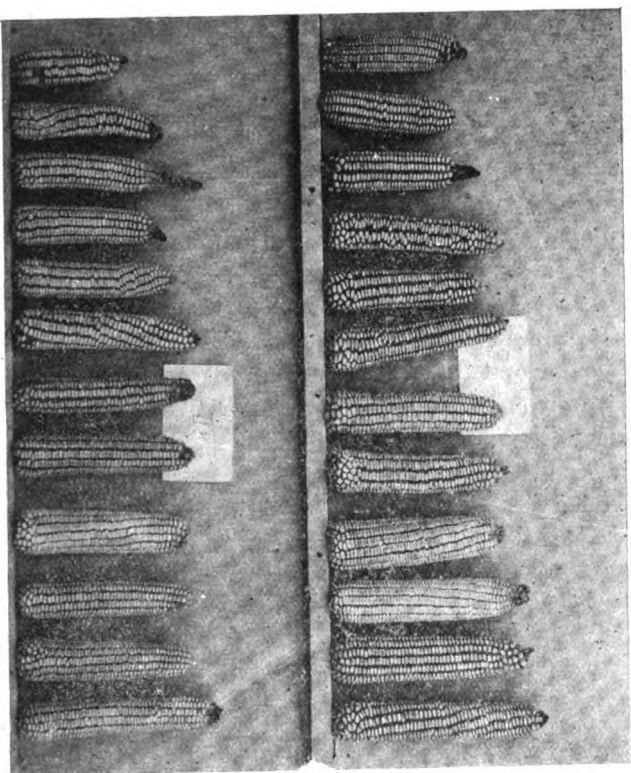


FIG. 1—Ears and nubbins of which the average weight is the average weight for the plot. (1, above) From check plot; (2, below) From Williamson plot.

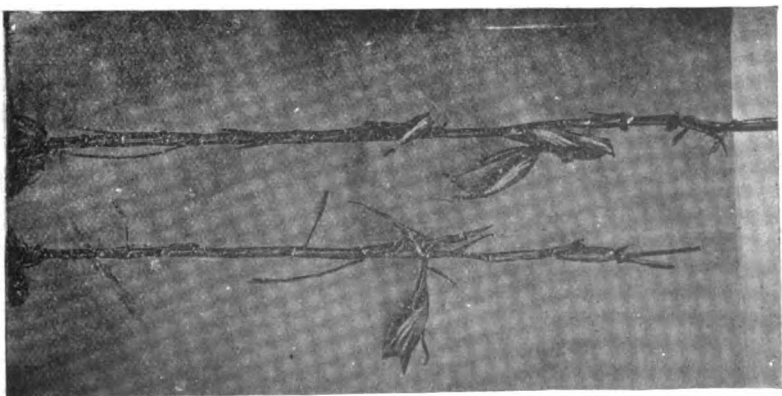


FIG. 2—Stalks after harvest showing relative average height of ears and size of stalks; the smaller plant is from the Williamson plot.

A study of the rainfall record for April, May, June and July indicates that at no time during the growing season did either plot suffer for moisture. The frequency of rains was doubtless favorable to the thick planting. Frequent rains at the time when cultivation of the Williamson plot was omitted prevented any injurious effect from this neglect. It is doubtful whether in average seasons such thick planting as was done on the Williamson plot (16 inches between plants) would have escaped disastrous firing.

It is obvious that we did not obtain profitable returns from this unusually large application of fertilizers; 1,000 pounds of commercial fertilizer cost \$12.80, while the value of the crop at 70 cents per bushel was only \$21.35. Our experiments in a number of localities in Alabama, and especially on a tract of gray sandy land similar and adjacent to that used for the Williamson experiment lead us to believe that the proportion of kainit in the Williamson fertilizer is too high.

It is an open question whether the unusually large yields obtained by Mr. Williamson on upland in South Carolina are not due more to the frequent plowing under of a crop of cowpea vines, to the liberal use of nitrogenous fertilizers, and to close planting, than to the dwarfing of the corn plant through omission of cultivation and withholding until late the application of fertilizers. Our previous experiments lead us most heartily to recommend plowing under a crop of cowpeas or other legumes as a fertilizer for corn, or the liberal use of nitrogenous fertilizers, and in many cases somewhat thicker planting than is customary, but a single year's test does not permit us to recommend all the details of the Williamson method. The experiment will be repeated, and in such a way as to inform us which of the details of the method are the really essential ones and responsible for the large yields sometimes secured.

cur/s  
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ALABAMA  
**Agricultural Experiment Station**  
OF THE  
Alabama Polytechnic Institute,  
AUBURN.

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**INJURIOUS INSECTS AND THEIR CONTROL.**

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By  
WARREN T. CLARKE,  
Entomologist

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# INJURIOUS INSECTS AND THEIR CONTROL.

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By

WARREN T. CLARKE.

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The agriculturist, no matter what crop he may be interested in, usually finds that he has to take into account and overcome, if may be, the ravages of insect pests. Sooner or later the question of means of control is sure to present itself to him, and on the solving of this question will depend the possible profit or loss in his farm operations. An intelligent knowledge of the fundamental principles governing the study of insect pests and an acquaintance with the best and most economical ways of applying these principles becomes therefore each day more necessary. The orchardist, the grower of field crops, the truck gardener, each of these must, to a certain extent, work out the problem in his own environment. The fact recognized that some insect is destroying entirely, or greatly reducing, the value of his crop is not sufficient knowledge upon which to base remedial measures. An acquaintance with the way in which the insect makes the damaging attack is necessary, and then the general character of the remedy to be used under these observed conditions must be known for effective work to be done.

It is not in the intention nor scope of the present Bulletin to give a complete treatise on the injurious insects of this state nor to lay down rules of procedure that will be entirely applicable in every case of damage that may arise. Indeed, there are questions in the control of certain insect pests that are today not solved, so we can only at present call attention to well known principles of procedure in such cases. On the other hand, there are many such questions that have received, either here or elsewhere, an ad-

equate answer, and, in a brief way, we may call attention to certain such specific cases.

#### METHOD OF INJURY.

The injury done by insects to cultivated crops may, for the present and in a general way, be considered as resulting from the insect's effort to get food. There are, undoubtedly, injurious effects to the plant frequently accompanying this food-getting effort that cause more damage to it than can be laid to the mere loss of material taken by the insect. However, the primary damage, from which these other causes of loss spring, is done by the insect in feeding upon the plant. It therefore becomes of importance to know just how the insect feeds, so that the character of the damage may be understood and further, that economical and practical means of control may be applied. The insect's method of eating largely determines the character of the control means to be used. Insects feed upon plants in one of two ways, and on these feeding methods the whole series of injurious insects can be divided into two great groups. Either the insect that is causing damage to our crops has *biting mouth parts* and obtains its food by eating out portions of the attacked plant, from the fruit, the leaves, the branches and trunk, or from the roots, or it has *sucking mouth parts* and obtains its food by piercing the tissue of the part of the plant attacked, and sucking the sap. These two very different methods of feeding are readily recognizable. The work of the leaf eating caterpillars, cut-worms; the damage caused by certain leaf attacking beetles; the feeding marks of grasshoppers upon twigs and branches; the gnawing out done by mole crickets in Irish potatoes; the burrowings and minings of various borers; these forms of damage are characteristic of the work of insects with biting mouth parts. It does not require a high degree of expert knowledge to determine the facts as to eating methods in such cases as these, yet on these facts will depend, in large measure, the method of control most likely to be effective. On the other hand, we shall find that the meth-

od of attack of the insects with sucking mouth parts is quite as characteristic and easily recognized.

#### POISONING.

If we determine that the insect in which we are interested, is of the biting type, devouring foliage, perhaps, then we know that it actually takes in particles of the plant as food, and we can infer that if poison is placed on this foliage it will become a part of the insect's diet and cause its death. On this determination will depend our use of such poisons as Paris green, arsenate of lead and similar toxic agents. These are known as internal or stomach poisons, are effective only when taken into the digestive tract, and do not trouble the generality of insects when in contact with them externally.

*Spraying With Paris Green.*—Paris green is an insoluble compound of arsenic and copper, and has received more attention and use in farm practice than has any other arsenical. If properly prepared it should carry but an extremely small percentage of free arsenic, and under these conditions it is generally not injurious to foliage, while being a very effective insecticide. It may be used as a spray in water or may be dusted on the plants or trees to be protected. When used as a spray the mixture should be made as follows:

Paris green .....	1 pound
Stone lime .....	4 pounds
Water .....	200 gallons

Mix the Paris green to a paste in a small quantity of water and then put in the spray tank with nearly the total amount of water to be used. Slack the lime in enough water to break it down completely, being careful, however, not to use enough water to "drown" it. Strain the milk of lime thus obtained through a sieve into the spray tank. Keep the whole mixture thoroughly and constantly stirred while spraying. In using this material as a spray, care must be exercised not to put too much upon the tree to be protected. While enough should be sprayed on to cover the leaves

and fruit with a film of the material, if the operation is continued beyond this point and dripping ensues, the leaf edges, and occasionally the entire leaf, will be destroyed by what may be termed arsenical burning. This is caused by an excessive amount of the arsenical being deposited where the running together and dripping occurs.

*Dusting Paris Green.*—Paris green is also used successfully in certain cases by dusting it upon the plant. This method is especially to be recommended where low growing plants, such as Irish potatoes, are to be protected from leaf-eating insects. When the dusting method is employed the poison should be mixed with some diluting material, such as hydrated lime (lime dust) flour or even fine roadside dust. The poison should be used in not greater quantity than four pounds of Paris green to fifty pounds of the dilutant and generally one half this strength will be found effective. The mixture can be successfully and economically applied to such low growing plants by placing it in a bag made of some loosely woven material and then shaking the bag over the plant that we desire to protect. The work should be done in the early morning while the plants are yet wet with dew so that the poison will stick to them. This is of course a primitive way to distribute poisons in the dust form but there are very effective dusting machines made and obtainable by those who desire more up to date appliances.

*Arsenate of lead.*—The arsenate of lead is also an insoluble arsenic compound and in the matter of possible damage to foliage is rather to be preferred over the Paris green. It is slightly more expensive than the latter material but requires no lime for its preparation and, when fresh, is somewhat easier to mix with water than is Paris green. It can be used as a spray at the rate of one and one half pounds arsenate of lead to one hundred gallons of water. At this rate its insecticidal value is good. Arsenate of lead is sold under various trade names and is commercially prepared for spraying purposes. It is not made in a dry form and cannot be used in the dusting method.

**Poisoned Baits.**—The use of arsenicals either as a spray or in the dust form is to be recommended then, in the majority of cases where the injury is distinctly caused by some leaf or twig eating insect with biting mouth parts. There are, however, exceptional cases where neither the dusting nor the spraying method will answer the purpose satisfactorily. This is especially true where so-called “cut-worms,” larvæ of certain moths, are causing the damage. When our problem is the control of these insects in vegetable patches or truck gardens, then the most satisfactory results will be obtained by what are known as “poisoned baits.” These depend for their killing principle upon either ordinary white arsenic or upon some one of the arsenical compounds as Paris green, London purple, or lead arsenate mixed with or put upon some food that is especially liked by the insects in question.

A quite effective poisoned bait may be made by dipping succulent leaves, such as cabbage leaves, in water in which either arsenic or some arsenic compound has been placed. The amount of the arsenical used may vary quite largely and the result still be satisfactory.

The writer has found the following proportions effective: One quarter pound white arsenic, or one half pound Paris green, to five gallons of water. The mixture should be kept well stirred and the leaves to be poisoned dipped in it. These leaves should then be placed on the ground near the plants to be protected. The work should preferably be done in the late afternoon for usually cut-worms feed in the evening and at night, and the bait will be more attractive to them when fresh. When such succulent leaves are easily obtained in quantity, the method above outlined is recommended.

In many instances, however, such leaves cannot be obtained and when this is the case a poisoned bait made as follows will be found to be thoroughly satisfactory:

Bran .....	40 pounds
Molasses .....	2 or 3 gallons
Arsenic (powdered white) .....	3 pounds

Water ..... 5 or 6 gallons

Mix the bran and arsenic together thoroughly while dry so that the poison will be well distributed in the whole mass. Add the molasses, mixing it and the poisoned bran well together. To this add enough water to make a fairly consistent mash. When a handful of the material will hold together in a ball, not too stiffly, enough water will have been added. Spread this bait about in small heaps near the plants that are to be protected. Usually cut-worms will feed rather greedily upon this material and their destruction ensues. This bait can be freshened by sprinkling a little water upon it as it lies on the ground. If Paris green is used instead of arsenic the weight of the former poison should be *five* pounds in the formula.

*Caution.*—Care should be exercised in all instances where arsenic or any of its compounds are used for insecticidal purposes. Domestic animals, cows, horses, swine, hens, turkeys, geese, etc., should not be allowed to feed or browse where these poisons are used. The materials should not be left where human beings might accidentally obtain a poisonous dose. No danger to human beings exists when the arsenic compounds are properly used as a spray to protect fruit or trees from insect ravages. The amount of the poison present on sprayed fruit is usually too small to constitute a dangerous factor. Obviously, no possible danger can exist so far as the edible product is concerned when poisoned baits are used.

#### MECHANICAL METHODS OF DESTROYING INSECT PESTS.

The use of poison sprays and baits, while generally valuable in the control of insects with biting mouth parts, is not effective in all such cases that may arise. When we have to deal with insects of this type, but which feed upon the internal parts of the plant, the use of these poisons is of no value inasmuch as it is impossible to place the poison in the situation where the insect is feeding. This restriction applies mainly to those insects known as "borers," the most destructive representative of which class that we have to deal with in this state being

the well known Peach Tree Borer. Where our problem consists of an attempt to control such pests as these, then mechanical means, so far as our present definite knowledge goes, must be resorted to. Using the insect just referred to, the Peach-Tree Borer, as representing this class of insects the mechanical means to be used, resolve themselves, finally to the actual cutting out and destruction of the individual insects. This may be accomplished by the use of very primitive tools, a good strong knife, indeed, doing effective work when properly handled or more elaborate implements may be employed. The so-called "Porter Hook," invented by Mr. C. M. Porter, of Douglas, Ga., will be found to be one of the most effective of "worming" tools. It consists essentially of a handle some twelve inches in length into which is firmly set a curved or "hook" blade. This blade is about six inches in length, not including the shank which is inset in the handle, and is well curved so that the straight distance from base of handle to point of blade is four and one half inches. The destruction, by mechanical means, of the borers being here considered can best be done in the fall or early winter. "The larvae are at this time—some eighty-odd per cent. of them—extremely small, and are, for the most part, still on the outside of the tree feeding on such tender spots as they may have located between the ridges and crevices of the bark, and generally involved in a mass of gum and excreta. This, and most of the larvae with it, may be cleaned away by a few rapid sweeps with a steel hook" (i.e., the Porter hook or some similar implement). "The mass of gum, with its content of wriggling caterpillar life, should be thrown or jerked from the hook to a distance of several feet from the tree, in order that the larvae may find it difficult to return and be subjected to capture by predatory agencies. The process of "worming" thus executed is most expeditious and economical and may be conducted on an extensive scale with most satisfactory results."\*

Whatever mechanical means may be employed for the

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\*Georgia Experiment Station Bulletin 73.



destruction of this or other borers, care must be exercised by the operator not to excessively wound or cut the tree. As much damage may be done the tree by careless or inefficient manipulation as would have been done by the borers that may have been destroyed in the operation.

The time above given and the method of work outlined does not, of course, apply to all the various species of borers attacking the different growths in which we may be interested. The general statement, however, may here be repeated that the work of control resolves itself into the careful cutting out, or probing for, the borer and the destruction of the individual pests and we may further emphasize the fact that the use of the arsenical poisons in such cases offers small hope of any success.

Certain injurious insects, notably the plum (or peach) curculio (*Conotrachelus nenuphar* Herbst.), have a habit of dropping to the ground and feigning death when disturbed. This habit is taken advantage of to destroy the insect. Sheets of cloth, upon light wooden frames, are placed beneath the affected trees which are then rather violently shaken or jarred. The disturbed insects fall on to the sheets and are collected from these and destroyed. The work should be done in the early morning when the insects are least active. The jarring process to be at all successful must be begun as soon as the insects are first noted upon the trees and fruit and must be continued until jarring fails to bring down enough to pay for the labor involved. This purely mechanical means of destroying these pests while being fairly satisfactory, so far as it goes, does not fully answer the question of their control. The writer has had occasion to note quite satisfactory results in controlling this pest by *spraying*. In the instance in question, the peach orchard was being sprayed with Bordeaux mixture to control the "brown rot" (*Monilia fructigena*.) The Bordeaux mixture was properly made by dissolving four pounds of copper sulphate (bluestone) in twenty gallons of water and by carefully slacking five pounds of clean stone lime and stirring the milk of lime or lime paste thus

obtained in twenty gallons of water. The copper sulphate solution and the lime water mixture were then poured together through a strainer into the spray tank and to the resulting Bordeaux mixture was added one pound of lead arsenate dissolved in a small quantity of water. The whole mixture was kept thoroughly stirred while being sprayed on the trees.

In the case noted this operation of spraying was repeated three times during the season and mainly to control the "brown-rot." The first application was made just before the blossoms opened and no poison added to the mixture; the second application, this time with the poison added, was made when the fruit had set, while a third application, again with poison, was made some three weeks later. The control obtained indicated considerable value in the method as above outlined. This spraying method of control, however, cannot as yet, be considered as superceding the method of mechanical control of the series of insects now being considered and until further data is at hand jarring for the curculio is the practice to be recommended.

The two methods of mechanical control of insect pests outlined in the preceding paragraphs, that is the destruction by individuals of borers and the shaking down and destroying in numbers such insects as the curculio, indicate lines of work that may have to be employed in certain specific cases. Necessarily the method of work employed will be governed by a study of the insect itself and its habits of life.

#### TRAP CROPS.

While the methods of work heretofore outlined offer means of control for many insect pests, when these methods have been adapted to the local conditions where the work is to be done, yet there are certain insects that cannot be reached by any of the ways noted. Such of our truck gardeners as are interested in the production of early tomatoes know the damage done by worms to the "bottom" or earliest crop of this vegetable. When this portion of the crop can be brought off uninjured the largest profit accrues to the grower.

The insect causing the greatest part of the loss to this portion of the tomato crop in this state, is the larval or caterpillar form of a moth scientifically known as *Heliothis obsoleta*. In the caterpillar form it is best known as the boll worm of cotton or as the corn worm. It is a destructive enemy of corn and especially of sweet corn and seems to prefer this latter to any other diet. The appearance of the larva or "worm" is familiar to all who have handled sweet corn "in the ear." This food preference can be successfully taken advantage of to control this pest in tomato fields where the saving of the "bottom" crop is a matter of importance, by planting sweet corn as a trap crop. The method to be used is as follows: Prepare the land fully four weeks before the tomato plants are to be removed from the frame and put out in the field. As soon as the land is prepared plant rows of sweet corn about twenty feet apart across the field. The corn should be planted in hills in the rows, these hills being a convenient distance apart for cultivating, so that they may not interfere with this operation after the tomatoes are set out. The sweet corn should be well up and growing before the tomatoes are placed in the field. The adult moth laying the eggs from which are produced the damage causing "worms" are attracted by the sweet corn and oviposit upon it and the tomatoes, in very large measure, escape injury. Of course no paying crop of corn need be expected under these conditions for the product will be too "wormy" to market. It will, however, have well served its purpose as a trap crop and can, at the proper time, be cut for fodder.

This "trap crop" method of controlling certain pests that are not controllable in any other way, deserves study and use upon the part of the truck gardener. It is, however, not to be considered as offering a ready means of relief in every case of insect injury that may arise.

#### FARM PRACTICE.

Closely related to the "trap crop" method of control of certain insect pests, in a method that may be designated under the rather broad title of "farm practice." There are

some insects which, owing to the fact that their place and way of feeding does not admit of it, cannot be well controlled by any of the methods outlined in the previous paragraphs. In certain such cases a study of the life history of the injurious insect indicates that by changes in our time of planting and method of work we can bring on the crop before or after, as the case may be, the pest is most active and hurtful. By this means, though the insects are not destroyed, we avoid the damage that might otherwise be great. One of the insects causing damage to corn in this state is commonly known as the "bud worm." This is the larval form of a beetle known scientifically as *Diabrotica 12-punctata*. This beetle is about one quarter inch in length, is yellowish-green in color, with the wing covers marked with twelve black spots. The head and the greater part of the legs is black. It is very fond of cucurbits and is frequently found in numbers on the blossoms of such plants as cucumbers and squashes. The larva ("bud worm") is white or yellowish in color, quite slender and soft bodied. It usually feeds upon the corn roots, though, as it grows older, it may eat directly into the stalk and destroy the plant. It is from this last form of attack that it has received the name, "bud worm." It has been noted that early planted corn is most likely to suffer from the attack of this pest. The method of farm practice suggested by this fact is obviously then *plant as late as possible* to avoid this injury by the "bud worm." In this connection it is as well to say that late planting will not entirely do away with this pest. A system of rotation of crops is highly desirable where this insect is present. This rotation should not include beans or cucurbits as both of these are acceptable food for the *Diabrotica*. Cotton may be used in the rotation with safety. There are undoubtedly many insect pests now present in our state whose damaging work would be much lessened by some such simple change in practice as that just noted. Where the method would be applicable, however, would be a matter to be determined by the study of individual cases.

Under this heading of "farm practice" we wish to call especial attention to an insect that will in the course of three or four years be of immense importance to the cotton growers of the state. Reference is here made to the Mexican Cotton Boll Weevil, an insect which has not yet made its appearance in Alabama, but whose arrival can be predicted with a fair degree of certainty. While the exact date of the introduction of this pest to this country is not known, yet it must have come here a short time before the year 1894, when the attention of the Bureau of Entomology of the U. S. Department of Agriculture was first called to it. It was then present and harmful to cotton in some seven or eight counties of Texas. Since that time, in spite of all control efforts, it has spread over a larger and larger territory until now the limit of its eastern dispersion is within thirty miles of the Mississippi river. Besides the enormous loss to the cotton crops in the states at present most affected by this pest, Texas and Louisiana, many thousands of dollars have been spent by these states and by the Bureau of Entomology in studies of the insect and in devising ways and means of control. These studies have developed, among other important items, the fact that the Mexican Cotton Boll Weevil hibernates as an adult. This means that a certain proportion of the full grown weevils live in the cotton fields, or in adjacent situations, through the winter and from these overwintering individuals are produced the first of the new series of weevils the following spring. A further important fact is that this weevil is confined to the cotton for its food. Based on these two facts is the method of control of this pest that has proved most satisfactory and it is one of "farm practice" purely. The method is in brief, as follows: First, plant as early as can be and avoid possible frost injury, using seed of some early maturing variety of cotton. Second, by thorough cultivation and the use of fertilizers force the cotton to early maturity. Third, as soon as the crop is made remove by cutting out, raking to windrows and burning, all cotton plants. While this procedure involves a change in

practice in cotton growing in this state yet it is a change that would benefit the industry were the Boll Weevil never to get here.

By this method an excessively long period of time results in which no cotton is available as food for the weevils and the number successfully hibernating is much reduced. It is not in the intention of this bulletin to enter very deeply into the subject of the Mexican Cotton Boll Weevil. It is sufficient for our present purpose to merely call attention to the great importance of the method of "farm practice" as applied in this and similar cases of insect attack where other methods offer scanty or no relief.

#### INSECTS WITH SUCKING MOUTH PARTS.

Our attention so far has been drawn to the insects that have biting mouth parts and that obtain their food by actually eating out portions of the attacked fruit or plant. There is, as was noted in our opening paragraphs, a series of insect pests whose method of eating is quite distinct and different from these so far spoken of. These insects have mouth parts so adapted, structurally, that they pierce through the outer covering of the plant or fruit attacked, and suck out the sap or juice. They do not use as food any of the outer part of the plant and as a consequence none of the poisoning methods heretofore spoken of are of any avail in their control. Another point of dissimilarity between these insects and the group designated as having biting mouth parts is that while the latter insects move about from place to place and do not, as a rule, gather together in fixed colonies, the series with sucking mouth parts have this bunching together, gregarious habit, strongly developed. Not only is the colonizing habit characteristic of these insects but in the most injurious representatives of the group we find that when the sucking mouth parts have been inserted in the plant tissue and feeding begun the individuals remain fixed in the chosen situation throughout the balance of their lives. This habit of restricted motility, as it may be termed, is especially evident among the so-called scale insects (*coccidae*) and in the

nearly related group of insects, the plant lice, (*aphididae*.)

The methods of control that are successful with these insects are based upon this life habit of restricted motility and in the main consist of the use of what are known as "contact insecticides." These insecticides depend for their killing power, not upon the introduction of some toxic agent to the digestive tract of the insect, but upon the effect that the agency used may have upon the insect when in contact with it externally. They may be caustic in their action, actually destroying the tissues of the insect, and so bringing about its death, or they may be oily in their nature and depend for their killing power upon entering the body of the insect through the breathing pores. These are situated upon the sides of the body, and through them and their connecting tubes, (*tracheae*), air is carried to all parts of the insect's body. While the exact action of the oily sprays upon the insect's respiratory system is problematical, still the value of these sprays depends upon their effect on this system. A third class of contact insecticides depend for their value upon their tendency to loosen the insect from its situation upon the plant and permit the action of the weather upon the thus exposed pest to cause its death. Each of the methods above outlined has its value in particular cases and under certain conditions.

#### CONTROL OF SCALE INSECTS.

The two pests among the scale insects causing the greatest losses in this state are the so-called San Jose Scale (*Aspidiotus perniciosus* Comst.) and the New or West Indian Peach Scale (*Aulacaspis pentagona* Targ.) The San Jose Scale is well distributed throughout the whole state while the West Indian Peach Scale is not quite so widespread in its distribution. Both insects belong in the group known as the armored scales which means that the living creature is covered over with an armor like shell which is composed of the cast skins (*exuviae*) of the insect and of a waxy material secreted by it. In both cases the individuals are extremely small and it is only their great numbers that make them a dangerous pest. It is not our in-

tention at the present time to enter into an extensive description of either of these insects. For a fuller discussion of the subject the reader is referred to Circular No. 1, issued from this department in October, 1906. It is enough to say here that the same means of control are applicable and recommended for both insects.

These consist solely of contact sprays and the one in most general use, and at present most satisfactory, is the so-called Lime-Sulfur-Salt spray. This may be made by the following formula:

Lime .....	30 pounds.
Sulfur .....	20 pounds.
Salt .....	5 pounds.
Water .....	60 gallons.

*Preparation.*\*—"For preparing the wash two vats or boilers are necessary, and if the spraying is to be done on a large scale, one of these, at least, should hold a couple of hundred gallons. If a smaller number of trees are to be treated, iron kettles will answer the purpose. Of course the preferable way of cooking the wash is by means of live steam.

Many ways have been suggested for mixing the materials, but the results are the same in every case, so long as the mixture has been subjected to the required amount of boiling. It is largely a matter of convenience, then, that determines the particular method, and the one found to best answer this requirement is as follows:

First, place two or three inches of water in the boiler, and to this add the sulfur, which has previously been made into a paste by mixing with hot water in order to remove the lumps, or sift the dry sulfur through a mosquito wire netting and stir in thoroughly. Then add about one fourth of the lime, and when the violent boiling has ceased add another fourth, and so on until the required amount of lime has been added. Hot water should be added with the lime as needed, so as to make the mixture a creamy consistency. Too much water will "drown" the lime while

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\*From Alabama Agric. Exper. Station, Circular No. 1, Oct. 1906.



on the other hand too little, will cause incomplete slaking of the lime. In this way the heat generated by the slaking lime is taken advantage of, and by adding the sulfur first, plenty of time is given for removing the lumps.

By the time the lime is thoroughly slaked the fire should continue the boiling, so that the time of boiling begins with the addition of the lime. The salt and about one-fourth of the water should now be added and the whole boiled from one to two hours, keeping it frequently stirred in the meantime. At the end of this period screen into the spray tank, add the necessary amount of *hot* water and apply to the trees hot.

The wash, when properly made, is a heavy reddish-brown liquid, very caustic and having a strong sulfur odor. The heavier materials settle upon standing, leaving a lighter liquid both in color and weight.

*Application*—On account of the heavier ingredients of the wash quickly settling to the bottom, means should be provided for agitating the mixture in the spray tank. This is best done, of course, by the power outfit. In the absence of this a gearing may be attached to the wheel of the wagon and the mixture agitated while going from one tree to another. A still simpler way is to stir frequently by means of a hoe or paddle.

The nozzle should be of the stopcock type, which will permit of ready cleaning. The type of spray should be a rather coarse one which will thoroughly wet the insects.

\* \* \* \* \*

Thoroughness in application cannot be too strongly urged, and *no part of the tree should escape treatment.*

*Time of application.*—The Lime-Sulfur-Salt wash is for winter use only. It must not be used when trees are growing for very grave injury will be the result if it is applied at that time. When the trees are dormant it can be safely used upon them. Such weather conditions in the winter as will permit work in the orchard will be satisfactory for applying the Lime-Sulfur-Salt wash."

The difficulty attendant upon the preparation of this wash has led to a large amount of experimentation with

other washes. Among the many materials used in this experimental work, the so-called "soluble oils" seem to offer the most promise and where winter work with the Lime-Sulfur-Salt preparation has been impossible, then it is advisable to use this material. It is known under different trade names and under the designation, "Scalecide," a quite desirable contact insecticide is sold. The spray made with this material can be used with safety in the spring and its results, when so used, are fairly satisfactory.

The main point to be observed in the use of this and all other contact insecticides is thoroughness of application. To be effective the material must come in direct contact with the insect to be destroyed.

#### PLANT LICE.

Another quite destructive series of insects with sucking mouth parts are the so-called "plant lice," the Aphids. These are soft bodied creatures, quite small, though generally larger than the scale insects, and are more easily destroyed than are the latter pests.

Certain species of aphids are well known to our truck gardeners, as for instance, the cabbage louse, (*Aphis brassicae*), while certain other series are quite destructive to orchard products and even to trees. When the attack of these insects is confined to the above ground parts of the tree or plant they can be quite readily destroyed by a spray made as follows: Dissolve one and one-half pounds of ordinary kitchen or laundry soap in one and one-half gallons of water. This can best be done by shaving the soap into boiling water and keeping the water boiling until the soap is fully dissolved. Remove from the fire and pour into the strong suds thus made one gallon of kerosene oil, stirring vigorously while pouring. Continue this vigorous stirring for fully ten minutes. The result should be a fairly stable creamy emulsion with no free oil. To the Kerosene Emulsion thus made add eighteen gallons of water and the spray is ready to be applied. It will be found quite effective as a destroyer of the majority of plant lice with which the grower will have to deal.

There are certain species of plant lice that attack not only the above ground portions but also feed upon the roots and root crowns of the trees. When our problem is the control of such insects as these, special methods of procedure are necessary. The best known of these pests is the Woolly Aphis of the apple—an insect that is familiar to all who are interested in the growth of this fruit. Very briefly we may say that the general method of procedure in such cases as these is to work in about the tree and root crown such materials as wood ashes or tobacco dust. These materials have a tendency to either destroy the insects or discourage their attack at the point where it is most damaging, the root crown. Special cases of this character, however, demand special study and treatment.

In the control of certain of the insects with sucking mouth parts no spraying or other method of ordinary procedure is of use and we are reduced to the practice of "hand picking" or jarring the insects off of the infested plants in our control efforts. This is true of the larger representatives of the series, as for example, the so-called "squash bug," (*Anasa tristis*), where spraying is of little or no value and control is obtained only by the removal and destruction of the individual insects.

There are many other insects of the type with sucking mouth parts to which attention might be called but we believe the purpose of this paper is served in citing the instances above noted.

Whether the insect causing damage is of the biting or sucking type, a reasonable study of it and its activities allows us to apply remedial measures far more economically and with a greater hope of success than would be the case without this study. The purpose of this Bulletin will have been served if it brings about a closer study of the insect causes of loss in this state and a more intelligent application of remedial measures.



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**Descriptions and Classification of Varieties  
of American Upland Cotton**

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**By**

**J. F. DUGGAR, *Director***

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The Bulletins of this Station will be sent free to any citizen of the State on Application to the Agricultural Experiment Station, Auburn, Alabama.

# DESCRIPTIONS AND CLASSIFICATION OF VARIETIES OF AMERICAN UPLAND COTTON.

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By J. F. DUGGAR, *Director*.  
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## REASONS FOR DESCRIBING AND CLASSIFYING VARIETIES.

The objects in view when this work was undertaken by the writer in 1899 were the following:

- (1) To determine what qualities accompany large yield of lint, so that farmers might be able to choose more intelligently the best of existing varieties according to their qualities.
- (2) To ascertain what characters are correlated, so as to lay a firmer foundation for rational schemes of breeding better varieties of cotton.
- (3) To obtain a better understanding of the meaning of variety tests made by the southern experiment stations, by ascertaining what *qualities*, rather than what *proper names*, have usually been associated with high yield under variable conditions of soil and climate.
- (4) To protect cotton farmers against the payment of exorbitant prices for seed of so-called new varieties in cases where the "novelty" was the same as some well-known old variety, seed of which could be obtained at a reasonable price.

The investigation is by no means completed and is being continued, especially to determine what characteristics may be combined in one plant and what qualities are antagonistic. The results of the first year's work in describing and classifying varieties was published in 1899 as Bulletin No. 107 of the Alabama Experiment Station. The present publication includes investigation of varieties made at Auburn, Alabama, in 1899, 1902, 1903, 1904, 1905, and 1906. During each of those years collections numbering 60 to 100 so-called varieties were grown, so that the data here published usually represent the average results of tests of the same variety extending through several years. Some of the recently introduced varieties, however, have been tested only one year.

## BASIS OF THIS CLASSIFICATION OF VARIETIES.

The cotton plant is very unstable, changing easily in many of its characters according to the climate and soil where it is grown. This tendency to vary with its surroundings is especially strong as regards the form of the plant, the length of the lint, and the size of the crop. Even the percentage of lint in the seed cotton varies some-

what from year to year. Moreover, the pollen may be carried from one variety to another by insects, thus producing hybrids from which still further variations arise. Because of these and other natural causes, it is to be expected that there should be numerous agricultural varieties of cotton differing from each other in slight and not very permanent qualities or characters.

Hence any attempt to classify agricultural varieties of cotton is more or less unsatisfactory. The gradations between varieties in any one agricultural character, for example, in size of boll, are so slight and gradual that positive identification of a single plant is practically impossible. However, it is believed that the averages,—for example, the average size of boll of a number of typical plants within one variety, taken in connection with the average of other qualities,—may be made the basis of a system of classification, which, though not infallible, will be useful. The classification here proposed is based, as far as considered practicable, on *groups* of qualities, rather than on a single character. Unfortunately the characteristics that are important to the farmer are those that vary most widely with change of environment.

The tentative scheme of classification here presented is practically the same as that published by the writer in 1899, in Bulletin No. 107 of the Alabama Experiment Station. A new group has been added to include chiefly varieties intermediate between the semi cluster and any other group.

#### UNIFORMITY NEEDED WITHIN A VARIETY.

Man has done quite as much as nature to increase the confusion as to the varieties of American upland cotton. The chief difficulty that has been encountered in the attempt to describe and classify cottons grown at Auburn under several hundred different names has been the absence of uniformity among the plants of a single variety. While this variability is partly due to natural agencies, it is also largely due to the failure of growers to avoid the mechanical admixture of the seed of other varieties, which so easily occurs at public gins. Worse still, in the case of many, perhaps most, of the so-called varieties, there has been no long period of selection through successive years with a view to fixing a uniform type.

A cotton ought to have a considerable degree of uniformity between the plants composing it before it is entitled to a name. If it is a selection from an old variety it may have this uniformity from the beginning, provided that undesirable qualities are cast out by careful selection. If the new cotton is a natural or artificial hybrid, or a mechanical mixture of two varieties, it will require at least several years of rigorous selection to secure any approach towards uniformity. Until this uniformity is secured it is neither just to the public nor advantageous of the exploiter to bestow a variety name.

It cannot be too strongly urged upon those who would originate new varieties of cotton that in selecting plants for seed they should select for the same quality or qualities every year. Stick to your ideal

year after year. If you find plants that are strong in some other quality than that you have heretofore had in mind, but different from the plants selected in previous years, either discard them or propagate them as a separate strain in a different field. Secure uniformity and special merit; until this is attained do not inflict the public with a new name and additional confusion and financial loss.

The confusion among varieties is still further increased by the re-naming of old varieties, innocently or for self interest, sometimes intentionally by growers or seedsmen, sometimes by one's neighbors. This practice cannot be too severely condemned, however innocently it is sometimes done. It is to be hoped that public sentiment will hold every exploiter of a new variety morally and financially responsible that what he sells at an advanced price under a new name shall be something more than a new name.

In the long run there is more profit to the grower in the legitimate business of selecting and selling improved seed of a good and well known variety under its true name than in selling it under a new name. Here right and self-interest are on the same side.

#### GROUPS OF VARIETIES.

The short staple or upland varieties of cotton may conveniently be divided into seven classes, and to these may be added the long staple upland varieties as an eighth. I would propose for each of these general classes a name, giving, when practicable, an idea of the manner of growth of the plant, and with each class name would associate the name of some distinct and well known variety as a type or standard. I shall designate these groups as—

- (1) Cluster varieties, or Dickson type.
- (2) Semi-cluster varieties, or Peerless type.
- (3) Rio Grande varieties, or Peterkin type.
- (4) The King-like varieties, or King type.
- (5) Big Boll varieties, or Truitt types.
- (6) Long Limb varieties, or Petit Gulf type.
- (7) Intermediate varieties, or various types.
- (8) Long Staple Upland varieties, or Allen type.

The lines of demarkation between these groups are not always clear and distinct; one group often merges into another by almost imperceptible gradations, just as is the case with related varieties.

Below is given a list of the varieties which are included under these several groupings, and also a general description of the varieties composing each class. Some varieties are not classified, either because of insufficient data, or more frequently because badly mixed. In cases of a medium degree of impurity, or variation, description has been made of the predominant type.

#### GROUP I.—CLUSTER VARIETIES, OR DICKSON TYPE.

The most striking characters are (1) the extreme shortness of the fruit limbs, and (2) the tendency of the bolls to grow in clusters,



often two and even three from the same node. The plants are often tall and always slender and normally erect, though often bent down by the weight of bolls growing near the upper end of the main stem. The few base limbs are often long, or there may be no wood limbs, especially when these varieties are closely crowded or grown on poor land. The bolls and seed are usually small, but may be of medium size;—the seed are thickly covered with fuzz, which is usually whitish, with little or no brownish or greenish tinge.

As to the time of maturity these varieties must be classed as early, even though they sometimes make a second growth of bolls in the top of the plant which may fail to mature. In earliness they are surpassed by the varieties of the King type (Class IV.)

In per centage of lint they are variable, some of them equalling in this respect the Rio Grande group.

Dickson, Jackson, (also called Limbless or African), U. S. Dept. Agr. No. 128, and Welborn, belong to this group. (See illustrations.)

#### GROUP II.—SEMI-CLUSTER VARIETIES, OR PEERLESS TYPE.

These varieties have in less marked degree some of the qualities which distinguish Class I, being erect and having bolls borne singly very near together. Along the main stem are short fruit limbs increasing in length towards the bottom of the stem. The two to five base or wood limbs are usually of medium length. In size of bolls and size of seed and percentage of lint there is considerable diversity among these varieties. The seed are usually well covered with fuzz of many shades, whitish, greenish, or brownish. Most of these varieties are early or medium, but some that belong in both the semi-cluster and big boll groups are late in maturing. The following varieties are included in the semi-cluster group: Barnett, Berryhill, Blue Ribbon (L. S.), Cummings, Defiance, Dongola (B. B.), Featherstone, Garrard, Haralson (B. B.), Hardin, Hawkins, Herndon, Hilliard, Lealand, McCall, Minor, Montclare (B. B.), Norris, Peerless, Pullnot, Rogers (B. B.), Sterling, Tyler, and Woodfin.

#### GROUP III.—RIO GRANDE VARIETIES, OR PETERKIN TYPE.

The characters which most distinctly mark this class are:

- (1) The large proportion of lint, usually 35 per cent. or more, of the weight of seed cotton, and
- (2) Seeds of which many are bare of fuzz, except at the tip end, or so scantily covered with fuzz that the dark seed coat shows through.

The plants are well branched, and usually, on upland soil, of medium size. On many plants the stems and branches are of a deep red color. The bolls are small to medium and the seed are quite small. In time of maturing these varieties are usually neither very early nor extremely late.

The varieties included in this group are conveniently divided into two sub-groups according to the presence or absence of naked, smooth

seed. The following Rio Grande varieties have a considerable proportion of naked seed: Anson Cream, Bates, Braddy, Brannon, Cameron, Carolina Queen, Champion, Combination, Crossland, Dixie Wilt-Resistant, Gayosa(?), Mattis(?), Moss, Parker, Peterkin, Pinkerton, Ptomey, Shine Black Seed, Sistrunk, Texas Oak, Texas Wood, Victor, and Wise.

Rio Grande varieties having practically no naked seed, but having many seed so scantily clothed with fuzz that the dark seed coat shows through, giving a brown color, are the following:

Berryhill, Borden, Dearing, (probably) Eureka, Excelsior(?), Favorite, (probably) Gregg, Layton, Park's Own, Speight, and (probably) Toole.

#### GROUP IV.—KING-LIKE VARIETIES, OR KING TYPE.

The varieties of this group are the earliest of American cottons. The plants are usually small but may be of medium size. The limbs are numerous and the fruit limbs are rather long in proportion to the height of plant. The fruit limbs are often crooked at the joints, reminding one of the crooked twigs of a black jack oak (*Quercus Marylandica*). The base limbs are short and sometimes replaced by fruit limbs bearing a number of bolls on each. King is essentially a short jointed, compact plant with an abundance of slender, rather crooked limbs. The bolls of this group are small; the seed are usually small and thickly covered with fuzz which is usually brownish, with an occasional seed showing a greenish tint. The percentage of lint is usually 33 to 35, and sometimes higher. King and its synonyms have on many blooms a red spot near the base of the inner portion of each petal. The varieties of this group are: Dozier, Grier, Golddust, Hodge, King, Lowry, Mascor, Missionary, and probably Shine Early.

#### GROUP V. BIG BOLL VARIETIES OR TRUITT TYPES.

The character which especially distinguishes this class is the large size of bolls, of which only 45 to 68 are required to yield a pound of seed cotton. Other specially notable qualities are late maturity and vigorous growth of stalk. The seed are large or very large, and covered with a thick fuzz, generally brownish white or whitish, a part of the seed of many of these varieties being covered with a deep green fuzz. The per cent. of lint often runs rather low and is usually between 31 and 34. The bolls are not closely clustered; in some varieties the upper limbs are so short as to give the top of the plant the erect, slender appearance which is common among semi-cluster varieties. In typical plants the base limbs are of short or medium length, the number of fruit limbs and bolls relatively few, and the main stem is rather short. However, a number of varieties are included here that have all or many of their plants of the semi-cluster form.

The following varieties belong in this group: Alex. Allen, Anderson, Bancroft, Banks, Berry, Bohemian, Brown No. 1 (?), Cheise,

Christopher, Cleveland, Cliett, Cook Improved (?), Coppedge, Culpepper, Diamond, Double Header, Dongola, Drake (Ala.), Duncan, Ellis, Grayson, Gunn, Haralson, Hunnicutt Big Boll, Hutchinson, Jones, Langford, Lee, Maddox, Montclare, Mortgage Lifter, Ozier Big Boll, Reliable, Rogers, Rowden, Ruralist, Russell, Scogin, Sewell, Schley, Smith Improved, Smith Standard, Southern Wonder, Spearman, Strickland, Tatum, Texas Bur, Texas Storm Proof, Thrash, Todd, Triumph, Truitt, Webber-Russell, Whitten, and Wyche.

**GROUP VI.—LONG LIMB UPLAND VARIETIES, OR PETIT GULF TYPE.**

The varieties in this class grow to large size and have long limbs and long joints, the plants presenting a straggling appearance or want of compactness. The bolls and seed are both of medium to large size, the latter covered with fuzz of various shades. The per cent. of lint is usually low. The long limb form is usually accompanied by unproductiveness on average upland soil.

The following varieties are included in this group: Hagaman, Louisiana, Peeler, Petit Gulf, and probably Red Leaf.

**GROUP VII.—INTERMEDIATE VARIETIES OR VARIOUS TYPES.**

This group is here added to the scheme of classification published by the writer in 1899, primarily to include varieties having limbs a little too long to bring them within the semi-cluster class. It is also made to include a few other varieties that are intermediate between any two of the other seven groups.

To this division are assigned, Breeden, Boyd, Edgeworth, Eureka, Excelsior, Gold Standard, Hunnicutt (J. B.), Lewis, Meredith, Roby, Rosser, (probably) Shine Early, Sprueill, (possibly) Toole, Tucker, and Webber-Russell.

**GROUP VIII.—LONG STAPLE VARIETIES, OR ALLEN TYPE.**

The length of staple is the distinguishing characteristic. The lint usually measures 1 1/4 to 1 1/2 inches in length, or 28 to 34 millimeters or more. An almost invariable accompaniment to great length of staple is a low proportion of lint.

The plants grow to large size, have limbs of great length, and usually present a straggling appearance, though in some varieties only the base limbs are long, the upper limbs bearing a number of bolls close to the main stem, and giving the upper portion of the plant the appearance of great prolificacy.

The bolls are not very large, but are long, usually slender, tapering to a sharp point. Most of these long staple varieties are late in maturing a crop.

The seed are mostly of medium to large size, usually densely covered with fuzz, from which all trace of green is absent, the color be-

ing almost pure white, or in some varieties of a brownish tint. In some varieties the seed are bare. In this group are included—

Allen Long Staple, Allen Hybrid Long Staple, Black Rattler, Blue Ribbon, Cobweb, Cook Long Staple, Colthorp, Davis, Doughy (?), Eclipse (?), Ferguson (?), Florodora, Gholson, Griffin, Keno, Laclede, Matthews (?), Moon (?), New Century (?), Ozier Long Staple, Simms, Southern Hope (?), Sunflower, and Wonderful.

The varieties followed by an interrogation point are on the dividing line as grown on dry sandy upland soil at Auburn. On moister soil they usually have fiber long enough to admit them into the long staple group, or into a subdivision of that class which may be called the medium staple group.

#### PRODUCTIVENESS OF VARIETIES.

Tests of the yields of lint per acre have been made at Auburn for 90 varieties, in addition to a much larger number grown on areas too small to indicate the yield. Their rank in the production of lint each year when a "plot" test was made is shown by the figures in the following table. To compare any two varieties let the reader use only the figures for those years when both varieties entered the test.

From this table it will be seen that among the varieties tested for a considerable number of years the following are frequently near the top of the list: **Peerless, Peterkin, Russell, and Truitt.**

Among the varieties that have been tested only a few years, the following have usually taken high rank in yield of lint: **Cleveland Cook Improved, Jackson, Layton, Pullnot, and Tole**

(See detailed descriptions, illustrations of plants, and outlines of bolls, of each variety, which are alphabetically arranged on subsequent pages of this bulletin.)

The lists just given of course do not include all the productive varieties, but only those that have been notably productive at Auburn after being tested here long enough to get average results for several years. Each variety is separately described and illustrated in alphabetical order in the following pages.

**TABLE I.—Rank of varieties of cotton on the basis of yield of lint per acre.**

TABLE I.	189	190	191	192	193	194	195	196	197	198	199	200	201	202
Alex. Allen												4	10	8
Allen Hybrid Long Staple							11	16						
Allen Long Staple	2		8	21			14					14		
Bailey				12	18									
Bancroft												4	17	
Barnett	4		3											
Berry													21	
Blue Ribbon												34	16	
Cameron												7	14	
Cherry Cluster	6		4	17										
Christopher													5	12
Cleveland													3	3
Colthorp Eureka				14	4									
Colthorp Pride				11	7									
Common				10										
Cook Improved												6	2	1
Cook, (W. A.) Long Staple			4	24	1									
Cook, (J. C.)				12										
Crossland				9									8	
Culpepper												11	16	9
Dalkeith Eureka				15	10									
Dearing							4	2	14					
Dickson		2		20		3	12						24	
Dixie Wilt Resistant													20	18
Doughty												10		
Drake ("Cluster?")												20		
Duncan						9	6		13					
Edgeworth												27		
Ellsworth	12													
Florodora												33		16
Garrard												27		
Gold Dust			7	22										
Grier's King												25		
Griffin Drought Proof							2							
Hagaman													12	
Hawkins	9		9	16		8	3		3	15	8	7		
Hierlong			6	23	6	13								
Lunnicut, (J. B.)			1	14		12	13							
Hitchinson						1	7	7						
Jackson										1	3	17		
Johnson Excelsior											28			
Jones Improved	5		10			10	5	8	7	24				
Jones No. 1				17										
Jones Long Staple			11	19	5	14								
Keith			5	11										
King	10			6	8		5			10	17	18	5	
Layton											2	5	2	
Lealand											38			
Lewis Prize											16			
Lowry										12				
Mascot											18			
Matthews Long Staple				7	11									
Meredith											30			
Mortgage Lifter											31			
Nancy Hanks											19			
Okra	9			13	12	8								
Parker											33			
Peeler				7	8									
Peerless	7	1		4	6		4	11						

TABLE I.—(Continued)

	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06
Peterkin		2		5	1			8	3	4	1	12	6
Petit Gulf				3	3		17						
Red Leaf											12	9	11
Pride of Georgia											29		10
Pullnot											8	5	4
Rameses	8			9									
Russell									1	8	20	6	15
Rowden											5		
Rogers											23		
Schley											25	5	
Shine											22	20	
Simms Long Staple											9		
Smith Improved									4				
Southern Hope		5		8	5								
Southern Wonder												15	
Storm Proof		4		15	2								
Strickland										11		7	
Sunflower											34		15
Texas Bur											13	13	
Texas Oak								1	6	6			
Toole												1	3
Truitt	1	3		2	4		2	9	5	2	24	16	14
Tyler							6	15		9			
Webber-Russell (U.S.D.A.)													13
Welborn Pet	3			11	13	2	15			5		22	
Whatley Improved						9	16	10					
Wise											5		
Woodfin Prolific											23	19	
Wonderful				14	16	1							
Zellner	11			1	10								
No. varieties in test	13	5	13	15	29	11	17	16	8	14	40	30	20

### NO ONE BEST VARIETY.

There is no one variety of cotton that is best for all soils and for all climatic conditions. At no experiment station has any single variety maintained the first place in productiveness year after year. When fall frosts occur at an early date the earlier varieties may have the advantage. An unusually late frost may place the late varieties far in the lead.

In years when a long staple commands a premium of four to six cents, a long staple variety, in spite of its usual lower productiveness will be more profitable on suitable land than ordinary or short-staple varieties. In other years, in other markets, and on dryer land, the most productive short staple variety may be far more profitable than a long staple.

After the invasion of the boll weevil, the best cotton to grow may not be the one that now makes the largest yield, but the one that forms a large proportion of its bolls so early in the season as to insure a crop before the weevils become excessively numerous. Likewise many other conditions keep any one variety from taking a position of universal pre-eminence.

The quality that is most universally desirable in a variety of cotton is productiveness, or high yield of lint per acre. With productiveness the farmer would be glad to unite as many of the following characters as possible:

- (1) Large size of boll, to facilitate picking.
- (2) Length of lint, with a view to a higher price per pound.
- (3) Earliness.
- (4) Storm resistance or ability to hold in the burr in spite of rain and wind, provided this quality shall not be accompanied by difficulty of picking.
- (5) Ease of picking, if not accompanied by excessive tendency for the seed cotton to be beaten or blown to the ground.

### CORRELATION OF CHARACTERS.

#### *Relation of size of bolls to size of seed and to production of lint.*

An analysis of the tables that follow shows that generally varieties with big bolls have also large seed. Thus of the 49 varieties having bolls so large as to require only 65 bolls or fewer per pound of seed cotton, all but 9 have seed averaging above .13 of a gram, and all but three have seed heavier than .12 of a gram. Langford and Spearman are notable exceptions to this generalization, the large size of their bolls being due to the great number (respectively 46 and 49) of rather small seed.

Likewise the varieties with smallest bolls are those with smallest seed.

In the plot tests at Auburn the most productive varieties have been found a little more frequently among the varieties having small seed (usually varieties of the Peterkin type), than among the big

boll group, which, however, has been well represented among the winners.

*High per cent. of lint is favorable to large yield of lint per acre, but not a necessary indication of large yield of lint.* Thus nearly half of the 16 varieties having highest per cent. of lint in Table III have proved to be especially productive. In further confirmation of this conclusion we may add that the 65 varieties having lowest percentages of lint (less than 32.9 per cent.), include not a single name that has given proof of unusual productiveness. Furthermore, the long staple varieties, generally recognized as considerably less productive of lint than the best short staple varieties, have a low or very low per cent. of lint, often below 30.

*High per cent. of lint is usually, but not always, accompanied by small seed.* However, Cook Improved, Haralson, Dongola and Montclare are among the exceptional examples showing that it is possible to combine high per cent. of lint with rather large seed (and also with large bolls and productiveness).

*Great length of fiber seems antagonistic to high per cent. of lint.* All the data for the long staple varieties constitute the foundation for this deduction.

*Relation of earliness to other qualities.* Taking the King-like varieties as representing extreme earliness of opening, we conclude that *the qualities usually associated with earliness are small size of boll, small size of seed, short length of fiber, and medium or below medium productiveness.* Since earliness, in the greater part of the cotton belt, is chiefly important as a means of lessening the injury from the boll weevil, when it shall have occupied the entire cotton growing area, we should mark Bennett's important distinction between early opening and early setting of bolls. He regards the latter as much the more important as a means of decreasing injury from boll weevils. We might reasonably expect early setting of bolls and early opening to occur together, but on this point additional data are needed. Bennett concludes that we may identify early plants by their having short "joints" and by their lowest fruit limbs being near the ground.

NOTE. In descriptions that follow, terms describing size of bolls or seed and per cent of lint are used in the sense indicated below:-

<i>Definitions.</i>	<i>Bolls.</i>	<i>Per cent lint.</i>	<i>Size of seed.</i>
Large (or high)	40-68 per lb.	36 or above	.13 gram or more
Medium	69-80 per lb.	33-36	.11-.13 gram
Small (or low)	80 or more per lb.	30-33	below .11 gram



TABLE II.—*Number of bolls required to make 1 pound of seed cotton*

	Years	Bolls per lb		Years	Bolls per lb
Triumph .....	1	46	Sprueill Green Seed .....	4	67
Double Header .....	1	47	Breeden .....	1	68
Anderson .....	1	49	Corput .....	2	68
Bohemian .....	1	49	Grayson .....	1	68
Hunnicut Big Boll .....	1	49	Hutchinson .....	2	68
Texas Storm Proof .....	1	50	Edgeworth .....	5	69
Cheise Improved .....	1	50	Hilliard .....	3	69
Todd .....	3	51	Rich Man's Pride .....	1	69
Diamond .....	1	52	Sprueill Re-Improved .....	2	69
Southern Wcnder .....	1	52	Alex. Allen (recently 60) .....	4	70
Sewell .....	1	54	Lealand .....	3	70
Banks .....	3	56	Wilson Matchless .....	1	70
Spearman .....	1	56	Gayosa Prize .....	1	71
Mortgage Lifter .....	3	58	McCall .....	1	71
Bancroft .....	3	58	Pullnot .....	3	71
Strickland .....	2	58	Simms Long Staple .....	3	71
Tatum .....	1	58	Brannon .....	2	72
Truitt .....	5	58	Cook Long Staple .....	5	72
Ellis .....	2	59	Meredith .....	2	72
Christopher .....	4	59	Sistrunk .....	1	72
Japan .....	1	59	Best .....	1	73
Wyche .....	1	59	Blue Ribbon (fuzzy seed) .....	4	73
Rowden .....	3	60	Parks Own .....	2	73
Smith Standard .....	1	60	Warren .....	1	73
Brown No. 1 .....	1	61	Red Leaf .....	3	73
Haralson .....	3	61	Carolina Queen .....	1	74
Holloway Storm Proof .....	1	61	Minor .....	2	74
Reliable .....	1	61	Nancy Hanks .....	3	74
Thrash Select .....	1	61	Rosser No. 1 .....	2	74
Berry .....	2	62	Big Boll .....	1	75
Jones Improved .....	4	62	Doughty Long Staple .....	5	75
Rogers .....	1	62	Little Improved .....	1	75
Russell .....	5	62	Parker .....	2	75
Webber-Russell .....	1	62	Braswell Cluster .....	1	76
Cliett Improved .....	2	62	Florodora .....	3	76
Culpepper .....	5	63	Garrard .....	3	76
Mongola .....	3	63	Gregg .....	1	76
Langford .....	1	63	Layton .....	3	76
Maddox .....	2	63	Dixie Wilt Resistant .....	3	76
Drake "Cluster" .....	5	64	Peterkin .....	5	76
Duncan .....	1	64	Branch Long Shank .....	1	77
Lee Improved .....	2	64	Gold Standard .....	3	77
Ruralist .....	2	64	Hardin .....	1	77
Whitten .....	1	64	Mawkins Jumbo .....	1	77
Cleveland .....	3	65	Hodge .....	1	77
Coppedge .....	1	65	Mattis .....	3	77
Doughty Big Boll .....	1	65	No. 145 (U. S. D. A. selection) .....	1	77
Gunn .....	3	65	Peerless .....	4	77
Montclare .....	3	65	Pride of Georgia .....	3	77
Texas Bur .....	4	65	Wise .....	5	77
Cook Improved .....	3	66	Cummings .....	3	78
Griffin .....	3	66	Favorite .....	1	78
Roby .....	1	66	King No. 3 .....	1	78
Scogin .....	3	66	Lewis Prize .....	3	78
Spruiell Prolific .....	1	66	New Century .....	2	78
Matthews Long Staple .....	2	67	Texas Oak .....	2	78
Schley .....	3	67	Bur .....	1	79
Smith Improved .....	3	67			

TABLE II.—(Continued)

	Years	Bolls per lb		Years	Bolls per lb
Hawkins	5	79	Ferguson	2	87
Lowry	2	79	King	4	87
Missionary	1	79	Butler	1	88
Mitchell	1	79	Borden Prolific	1	89
Moss	2	79	Cobweb	3	89
Norris	1	79	Excelsior	4	89
Ozier	2	79	Herlong	1	89
Pinkerton	3	79	Ptomey	1	89
Speight	1	79	Victor	2	89
Blue Ribbon (black seed)	4	80	Anson Cream	2	90
Todd Early	1	80	Bates Little Brown	1	90
Tucker	2	80	Shine Early	5	90
Berryhill	4	81	Black Rattler	2	91
Gholson Long Staple	2	81	Welborn	3	91
Improved Long Staple	1	81	Cameron Early	4	92
Johnson Excelsior	1	81	Toole	3	92
No. 146 (U. S. D. A selection)	2	81	Eclipse	1	93
Petit Gulf	2	81	Shine Black Seed	3	93
Boyd Prolific	3	82	Merling	2	93
Jackson	5	82	Woodfin Prolific	1	94
King No. 1	4	82	Eureka	1	95
Bingham	1	83	Bates Poor Land	1	96
Grier	3	83	Defiance (Drake)	1	96
Dozier	1	83	Laclede	1	96
Moon	1	83	Combination	1	97
Ozier Long Staple	1	83	Colthorp	3	98
Sunflower	3	83	Mascot	2	98
Woodfin Non-Pariel	3	83	Braddy	2	99
Allen Long Staple	4	84	Early Gayosa	1	99
Crossland	3	84	Shine No. 2	1	100
Extra Early	1	84	Dearing	2	102
Hagaman	2	85	Dickson	3	104
Herndon Select	3	85	Keno	1	104
Texas Wood	4	85	Barnett	2	105
Allen Hybrid Long Staple	1	86	Seabrook (Sea Island)	1	112
Tyler Limb Cluster	1	86	Sea Island	3	127

TABLE III.—Varieties of cotton arranged according to per cent of lint

	per cent lint		per cent lint
Shine No. 2 .....	141.5	Langford .....	135.1
Victor .....	240.5	Garrard .....	335.0
Bates Little Brown .....	139.6	Rosser No. 1 .....	235.0
Wise .....	539.5	Maddox .....	234.9
Layton .....	339.0	Tucker .....	234.9
Cook Improved .....	338.9	Cliett .....	234.8
Todd Early .....	138.9	Breeden .....	134.7
Combination .....	138.8	Culpepper .....	534.7
Eureka .....	138.6	Pride of Georgia .....	334.7
Triumph .....	138.6	Hawkins .....	534.6
Toole .....	338.5	Hilliard .....	333.6
Favorite .....	138.3	No. 146 (U. S. D. A. selec- tion) .....	234.5
Moss .....	238.3	Excelsior (Moore) .....	434.5
Haralson .....	338.2	Hutchinson .....	234.4
Jackson .....	538.0	McCall .....	134.4
Peterkin .....	538.0	Minor .....	234.4
Roby .....	138.0	Mortgage Lifter .....	434.4
Berryhill .....	437.8	No. 145 (U. S. D. A. selec- tion) .....	134.4
Braddy .....	237.8	Webber-Russell .....	134.4
Brown No. 1 .....	137.7	Alex. Allen .....	434.3
Grier .....	337.7	Braswell Cluster .....	134.3
Johnson Excelsior .....	137.7	Christopher .....	434.3
Little .....	137.7	Hagaman .....	234.3
Bates Poor Land .....	137.6	Missionary .....	134.3
Borden .....	137.5	Sprueill Green Seed .....	434.3
Crossland .....	337.5	Defiance (Drake) .....	134.2
King No. 1 .....	437.5	Texas Oak .....	234.2
Whitten .....	137.4	Louble Header .....	134.1
Texas Wood .....	437.2	herlong .....	134.1
Blue Ribbon (wooly seed) .....	437.0	Schley .....	334.1
Sistrunk .....	136.9	Smith Improved .....	334.0
Cameron Early .....	436.8	Southern Hope .....	334.0
Montclare .....	336.8	Woodfin Prolific .....	134.0
Shine Black Seed .....	336.8	Parks Own .....	233.9
Red Leaf .....	336.8	Warren .....	133.8
Brannon .....	236.4	Boyd Prolific .....	333.7
Gregg .....	136.4	Cheise Improved .....	133.7
Pullnot .....	336.3	Dozier .....	133.7
King .....	436.3	Speight .....	133.7
Thrash .....	136.2	Banks .....	333.6
Rich Man's Pride .....	136.2	Clithorp .....	333.6
Pinkerton .....	336.2	Branch Long Shank .....	133.6
Gold Standard .....	336.1	Lealand .....	333.6
Rowden .....	336.0	No. 149 (U. S. D. A. selec- tion) .....	133.5
Dongola .....	336.0	Ozier .....	233.6
Carolina Queen .....	135.8	Holloway Storm Proof .....	133.5
Lewis Prize .....	335.8	King No. 3 .....	133.5
Mascot .....	235.8	New Century .....	233.5
Edgeworth .....	535.7	Sterling .....	233.5
Rogers .....	135.7	Peerless .....	433.4
Nancy Hanks .....	335.6	Tatum Big Boll .....	133.2
Welborn .....	335.6	Texas Bur .....	433.2
Ptomy .....	135.5	Tyler Limb Cluster .....	133.2
Hodge .....	135.4	Herndon Select .....	333.1
Extra Early .....	135.3		
Anson Cream .....	235.2		
Bingham .....	135.2		
Cleveland .....	335.1		

TABLE III.—(Continued.)

	Years	per cent		Years	per cent
<b>Lowry</b> .....	2	33.1	<b>Griffin</b> .....	3	31.7
<b>Dixie Wilt Resistant</b> .....	1	33.1	<b>Early Gayosa</b> .....	1	31.5
<b>Texas Storm Proof</b> .....	1	33.1	<b>Corput</b> .....	2	31.4
<b>Parker</b> .....	2	33.1	<b>Matthews Long Staple</b> .....	2	31.4
<b>Wyche Big Boll</b> .....	1	33.1	<b>Florodora</b> .....	3	31.3
<b>Doughty Big Boll</b> .....	1	33.0	<b>Ozier Long Staple</b> .....	1	31.3
<b>Reliable</b> .....	1	33.0	<b>Simms Long Staple</b> .....	3	31.3
<b>Todd Improved</b> .....	3	33.0	<b>Gholson Long Staple</b> .....	2	31.2
<b>Bancroft Herlong</b> .....	3	32.9	<b>Norris</b> .....	1	31.2
<b>Jones Improved</b> .....	4	32.9	<b>Ferguson</b> .....	2	31.2
<b>Russell</b> .....	5	32.9	<b>Hawkins Jumbo</b> .....	1	31.1
<b>Truitt</b> .....	4	32.9	<b>Scogin</b> .....	3	31.1
<b>Blue Ribbon (black seed)</b> ..	4	32.8	<b>Black Rattler</b> .....	2	31.0
<b>Bohemian</b> .....	1	32.8	<b>Dearing</b> .....	2	31.0
<b>Burr</b> .....	1	32.8	<b>Laclede</b> .....	1	31.0
<b>Coppedge</b> .....	1	32.8	<b>Sewell</b> .....	1	31.0
<b>Drake "Cluster"</b> .....	5	32.8	<b>Anderson</b> .....	1	30.9
<b>Meredith</b> .....	2	32.8	<b>Grayson</b> .....	1	30.8
<b>Moon Long Staple</b> .....	1	32.7	<b>Hunnicutt Big Boll</b> .....	1	30.8
<b>Sprueill Re-Improved</b> .....	2	32.6	<b>Butler</b> .....	1	30.4
<b>Strickland</b> .....	3	32.5	<b>Smith Improved</b> .....	3	30.4
<b>Berry</b> .....	2	32.4	<b>Hardin</b> .....	1	30.3
<b>Keno</b> .....	1	32.4	<b>Ruralist</b> .....	2	30.3
<b>Mattis</b> .....	3	32.4	<b>Cook Long Staple</b> .....	5	30.2
<b>Dickson</b> .....	3	32.3	<b>Eclipse</b> .....	1	30.2
<b>Lee</b> .....	2	32.3	<b>Doughty</b> .....	5	30.1
<b>Barnet</b> .....	2	32.2	<b>Duncan</b> .....	1	30.0
<b>Wilson</b> .....	1	32.2	<b>Japan</b> .....	1	29.7
<b>Big Boll</b> .....	1	32.1	<b>Sprueill Prolific</b> .....	1	29.5
<b>Cummings</b> .....	3	32.1	<b>Davis Long Staple</b> .....	2	29.2
<b>Ellis</b> .....	2	32.1	<b>Sunflower Long Staple</b> .....	3	29.2
<b>Gunn</b> .....	3	32.1	<b>Diamond</b> .....	1	29.1
<b>Best</b> .....	1	32.0	<b>Cobweo</b> .....	3	28.3
<b>Shine Early</b> .....	5	32.0	<b>Improved</b> .....	1	28.3
<b>Woodfin</b> .....	3	32.0	<b>Seabrook</b> .....	1	28.1
<b>Spearman</b> .....	1	31.9	<b>Allen Long Staple</b> .....	4	28.0
<b>Mitchell</b> .....	1	31.8	<b>Allen Hybrid Long Staple</b> ..	1	26.9
<b>Petit Gulf</b> .....	2	31.8	<b>Sea Island</b> .....	3	26.5
			<b>Gayosa Prize</b> .....	1	24.9

TABLE IV. - *Weight of 100 seed; varieties arranged according to size of seed.*

	Years	Grams		Years	Grams
Todd Improved	3	16.89	Cook Improved	3	12.63
Duncan	1	16.64	Improved Long Staple	1	12.63
Sewell	1	16.54	Triumph	1	12.66
Bancroft Herlong	3	16.40	Hutchinson	2	12.62
Banks	3	16.23	Norris	1	12.62
Gayosa Prize	1	16.03	Doughty Big Boll	1	12.57
Holloway's Storm Proof	1	16.03	Braswell	1	12.36
Texas Storm Proof	1	15.98	Scogin	3	12.49
Rowden	3	15.91	Big Boll	1	12.48
Anderson	1	15.58	Cook (W. A.) Long Staple	5	12.48
Spruiell Prolific	1	15.53	Hawkins Jumbo	1	12.44
Thrash	1	15.52	Sprueill Green Seed	4	12.40
Double Header	1	15.34	Cleveland	3	12.33
Ellis	2	15.31	Cummings	3	12.36
Mortgage Lifter	3	15.27	Rich Man's Pride	1	12.32
Truitt	4	15.06	McCall	1	12.29
Lealand	3	15.04	Webber-Russell	1	12.26
Strickland	2	14.96	Alex. Allen	4	12.19
Maddox	2	14.95	Parks	2	12.13
Cheise Improved	1	14.82	Texas Bur	4	12.12
Southern Wonder	1	14.74	Ruralist	2	12.11
Lee Improved	2	14.46	Pullnot	3	12.00
Russell	5	14.34	Bur	1	11.98
Coppedge Improved	1	14.32	Hilliard	3	11.88
Rogers	1	14.30	Lowry	2	11.82
Diamond	1	14.28	Meredith	2	11.82
Hunnicut Big Boll	1	14.27	New Century	2	11.81
Dongola	3	13.92	Floradora	3	11.77
Cliett	2	13.87	Garrard	3	11.76
Berry Big Boll	2	13.85	Cobweb	3	11.75
Culpepper	5	13.65	Edgeworth	5	11.71
Matthews Long Staple	2	13.62	Moon	1	11.70
Best	1	13.55	Tatum	1	11.61
Bohemian	1	13.54	Breeden	1	11.58
Christopher	4	13.53	Allen Hybrid Long Staple	1	11.56
Smith Standard	1	13.49	Griffin	3	11.45
Gurn	3	13.46	Mitchell	1	11.44
Grayson	1	13.44	S. nms Long Staple	3	11.44
Japan	1	13.44	Ferguson	2	11.37
Montclare	3	13.37	King No. 3	1	11.32
Brown No. 1	1	13.29	Schley	4	11.25
Smith Improved	3	13.27	Seabrook (Sea Island)	1	11.16
Wyche Big Boll	1	13.27	Blue Ribbon (black seed)	4	11.12
Peerless	4	13.24	Roby	1	11.10
Haralson	3	13.19	Hawkins	5	11.07
Jones Improved	4	13.19	Gholson Long Staple	2	11.06
Whitten	1	13.19	Minor	2	11.03
Drake "Cluster"	5	13.16	No. 145 (U. S. D. A. selection)	1	10.94
Sea Island	3	13.15	Johnson Excelsior	1	10.90
Blue Ribbon (fuzzy seed)	1	13.10	Nancy Hanks	3	10.88
Branch Long Shank	1	13.06	Excelsior	4	10.84
Doughty Long Staple	5	13.06	No. 149 (U. S. D. A. selection)	1	10.84
Corput	2	12.99	Parker	2	10.76
Sprueill Re-Improved	2	12.82	Bingham	1	10.75
Ozier Big Boll	2	12.75	Warren	1	10.71
Reliable	1	12.70	Defiance (Drake)	1	10.70

TABLE IV.—(Continued.)

	Years	Grams		Years	Grams
Pride of Georgia .....	3	10.70	Early Gayosa .....	1	9.78
Pinkerton .....	3	10.69	Ferryhill .....	4	9.77
Dixie Wilt Resistant .....	1	10.67	Colthorp .....	3	9.68
Orier Long Staple .....	1	10.66	hodge .....	1	9.69
Langford .....	1	10.63	King .....	4	9.66
Spearman .....	1	10.57	Texas Oak .....	2	9.66
Boyd Prolific .....	3	10.55	Wilson .....	1	9.62
Gregg .....	1	10.55	Crossland .....	3	9.60
Hardin .....	1	10.52	Dickson .....	3	9.59
Sunflower .....	3	10.52	Todd Early .....	1	9.58
Rosser No. 1. ....	2	10.44	Peterkin .....	5	9.52
Brannon .....	2	10.41	Jackson .....	5	9.51
Little .....	1	10.40	Keno .....	1	9.48
Petit Gulf .....	2	10.39	Ptomey .....	1	9.45
Allen Long Staple .....	4	10.38	Lewis Prize .....	3	9.43
Gold Standard .....	3	10.36	Black Rattler .....	2	9.39
Hagaman .....	2	10.36	Woodfin Prolific .....	1	9.38
Mattis .....	3	10.33	Dozier .....	1	9.33
Carolina Queen .....	1	10.31	Herndon Select .....	3	9.20
Grier .....	3	10.21	Mascot .....	2	9.13
No. 146 (U. S. D. A.) .....	2	10.21	Laclede .....	1	8.97
Texas Wood .....	4	10.17	Cameron Early .....	4	8.94
Shine Early .....	5	10.16	Layton .....	3	8.88
Red Leaf .....	3	10.15	Wise .....	5	8.72
Woodfin .....	3	10.11	Favorite .....	1	8.70
Borden .....	1	10.04	Toole .....	3	8.57
Moss .....	2	9.98	Barnett .....	2	8.56
Welborn .....	3	9.97	Shine Black Seed .....	3	8.38
Herlong .....	1	9.96	Tyler .....	1	8.36
Eclipse .....	1	9.94	Victor .....	2	8.33
Tucker Improved .....	2	9.92	Extra Early .....	1	8.26
Daring .....	2	9.89	Butler .....	1	8.18
anson Cream .....	2	9.88	Combination .....	1	8.17
Sistrunk .....	1	9.84	Bates Poor Land .....	1	8.16
Sterling .....	2	9.84	Eureka .....	1	8.05
King No. 2. ....	1	9.82	Shine No. 2. ....	1	8.03
Speight .....	1	9.82	Braddy .....	2	7.64
Assionary .....	1	9.80	Bates Little Brown .....	1	5.48

CONDITIONS UNDER WHICH THESE DESCRIPTIONS, PHOTOGRAPHS AND  
WEIGHINGS WERE MADE.

All descriptions and photographs herein published were made from typical plants grown at Auburn, Alabama, on upland fields. The soil here is sandy and dry and under these conditions the cotton plant makes relatively a small growth of stalk. The fiber of the long staple varieties is shorter here than when the same variety is grown in moister soil. Time and conditions have not thus far permitted careful and repeated measurements of fiber, and until this can be done by more accurate methods than are sometimes used, it is thought best to make no comments on the character of fiber except where the staple is distinctive. There has usually been an application of from 400 to 600 pounds of complete fertilizer per acre, and the average yield for different years has varied from about three-fourths to about one and one-eighth bales per acre. Photographs were taken about the time of first frost, and since the date of making the photographs necessarily varied, the pictures should not be taken as indicating relative earliness of varieties. Neither do the figures show the relative sizes of plants. The drawings of bolls are exactly the same size as the original boll, chosen as apparently typical of each variety.

Data as to size of bolls, weight of seed, per cent of lint, etc., are as a rule based on the average of three samples for each year that the given variety was tested, or fifteen separate samples in the case of a variety tested five years. The lint was removed by hand picking, and comparisons with percentages of lint from ginning some of the same varieties show but little difference, say 1.2 to 1 per cent higher for hand picking. The area available did not permit the growing of all varieties on plots large enough to determine the yield per acre. Where such yields were determined they are indicated in Table I.

The writer cheerfully records his obligations to those who have assisted in this work, especially to L. N. Duncan, Assistant Agriculturist, who has prepared most of the tables from our records, and has otherwise given most effective help. Among others to whom credit is due are C. M. Floyd, Superintendent of the Farm, and C. R. Hudson, formerly Assistant Agriculturist.

The writer is well aware that the plain statement of the undesirable qualities, or the failure to find conspicuous merit in a variety, may bring disappointment to the originator or exploiter and may perhaps bring censure upon the experimenter. However, conscious of entire impartiality, recognizing the possibility of errors of judgment and the limitations imposed by the small number of tests of certain recently introduced varieties, he can only present his findings with the hope that they will aid the farmer to choose the variety best for his conditions and to point out merits and defects, note of which may aid originators of new varieties still further to improve their creations.

## DESCRIPTIONS OF VARIETIES.

*Alex Allen.*—This is a variety which A. W. Allen, Temple, Ga., states that he originated in 1898 from a single plant found in a field of mixed varieties. This is a compact, erect, big boll variety with semi-cluster form. Plants medium size, short jointed. Maturity early to medium. The bolls the last two years averaged 60 per pound of seed cotton, or larger than in our earlier tests. Storm resistance slight; per cent of lint medium or above, (34.3). Seed medium in size, fuzzy, mostly white, but some of them greenish white and some brownish white. Lint short. Rank in yield of lint in field tests at Auburn 4th, 10th and 8th. This is a promising prolific variety, useful on account of its yield, earliness, and large size of bolls.

*Allen.*—(Synonyms, Allen Long Staple, Allen Improved, Allen Silk, and Talbot). Originated by James B. Allen, Port Gibson, Miss., who reports it to be a cross between his Allen Hybrid and Yellow Bloom. The plants are tall with long base limbs and numerous rather short central and upper limbs. Maturity medium to late. Bolls small (84 per pound of seed cotton), or small to medium, and pointed; locks 4 or 5; storm resistance, slight. Per cent. of lint very low, (28 per cent.) Seed small to medium as judged by weight, (.104 gram), but appearing large because of abundant fuzz. Lint very long and fine. Rank in yield 2nd, 18th, 14th, and 21st. This is a well established, standard long staple variety, with excellent quality of lint and a well balled plant.

*Allen Hybrid Long Staple.*—This is one of the earlier varieties originated by James B. Allen, Port Gibson, Miss., and is one of the parents of Allen Long Staple. As grown here it differed but slightly, if at all, from its descendant. The bolls are small (86 per pound of seed cotton); per cent of lint very low (26.9); seed small and fuzzy, mostly white. Maturity late. Rank in yield of lint 11th and 16th.

*African.*—(See Jackson).

*Anderson.*—Grown only in 1906. Seed received from J. F. Anderson, Williamson, Ga. This is a big boll variety with plant typical of that group, but better supplied with bolls than the average big boll variety. On type of plant this was regarded as one of the best of the big boll varieties grown at Auburn for the first time in 1906. However, the low per cent. of lint, (30.9), makes further test necessary before we can pronounce this variety a productive one. Plant medium in maturity and in height; limbs medium length; bolls very large (49 per pound), mostly five locks, opening wide. Seed very large and fuzzy, white and pale greenish white. Lint medium in length. Yield not determined.

*Anson Cream.*—(Synonym, probably Peterkin). Seed was obtained from North Carolina. This variety belongs in the Rio Grande group and is probably a local name for, or a selection from, Peterkin. Seed of some plants are naked, while seed of other plants,



that are probably impurities, are densely covered with whitish brown fuzz. (See Peterkin.)

*Bancroft.*—(Synonym, Bancroft Herlong, Jones Herlong, and probably Russell.) Seed was obtained from E. Bancroft, Athens, Ga. This old variety belongs in the big boll group, and has a rather short-limbed plant. The bolls are large, 58 per pound, long, tapering gradually to a point. The seed are large, fuzzy, deep green and brownish green. Maturity late. The leaves have the large size and relatively shallow indentations between lobes that distinguish the leaves of Russell. This variety is probably the parent of the Russell, for in size and shape of leaves, in size and shape of boll, and in color and size of seed the two are practically identical. Lint medium in length. Rank in yield of lint at Auburn 4th and 17th.

*Banks.*—(Synonym, Banks Big Boll). This is a big boll variety with limbs of medium length. The bolls are large (56 per pound), roundish, either blunt or abruptly pointed. Locks mostly 4. Storm resistance medium. This variety very closely resembles Truitt in form of plant, size of bolls, size and appearance of seed, and in per cent of lint (33.6); seed very large, (.163 gram), fuzzy, whitish brown. Lint of medium length. Maturity medium.

*Bailey.*—This variety, which was grown at Auburn about 1890-1893, is now probably extinct. As described in Alabama Experiment Station Bulletins 33 and 56, Bailey cotton had a small prolific plant, with branches of medium length, long "joints," small roundish bolls; seed small, mostly naked and black; staple of medium length; maturity early; per cent of lint very low.

*Barnes.*—(Synonym, Baggarly). Grown only in 1903, using seed from J. R. Banks, Newnan, Ga. There are several types of plants, one similar to Russell, another to the long limb group, and some plants resembling Peterkin. The data given in tables are from the plants resembling Russell.

*Barnett.*—An old semi-cluster variety now almost or quite extinct. The plants are not very uniform, and are of medium maturity and fruitfulness. The bolls are small, roundish or ovate, some of them abruptly pointed, mostly 4 locks per boll. Per cent of lint below medium (32.2), although the seed as recently obtained were small and exactly similar in appearance to Peterkin.

*Bate's Little Brown.*—(See Peterkin.) Seed was obtained from R. Bates, Jackson, S. C. In all important qualities this cotton is similar to Peterkin.

*Bates's Poor Land.*—(Synonyms, Peterkin, Bates Little Brown). Seed was obtained from R. Bates, Jackson, S. C. In all important qualities similar to Peterkin and Bates's Little Brown.

*Berryhill.*—F. M. Berryhill, Aline, Amite County, Mississippi, states that he originated this variety in 1898 by selection from Brannon. This variety contains some plants resembling in form Peterkin and King, but more of the semi-cluster form. The seed are small, fuzzy, mostly brownish; per cent lint 38; bolls small (81 per pound). In maturity it is medium to early; moderately prolific.

**Locks mostly 5.** This variety is very similar to Lewis.

**Berry.**—(Synonym, *Berry Big Boll*). J. L. Berry, Griffin, Ga., states that he originated this in 1896, from unknown parentage. This is a big boll variety. The bolls are large, (averaging 62 per pound), abruptly pointed. The per cent of lint averaged low, (32.4). The seed are large, fuzzy, mostly white, greenish white, and brownish white. In all of the qualities mentioned above Berry is similar to Truitt, but differs from the latter in being earlier. Locks 4 to 5. Storm resistance fair. Rank in yield of lint at Auburn in 1905, 21st. The most promising characteristic of this variety is its earliness for a big boll variety.

**Best.**—Grown only in 1903. Plants of the King form, but per cent of lint lower and size of bolls larger than that type. Maturity early. Seed greenish white.

**Big Boll.**—Of doubtful classification, the bolls being of medium size and too small to admit it to the big boll class, to which in other qualities it would belong.

**Bingham.**—Grown only in 1895. This is apparently a mixed variety, having some long limb and some almost semi-cluster plants. Seed small to medium, brownish to greenish. Locks mostly 5. Per cent of lint medium or above. Bolls small (83 per pound of seed cotton).

**Black Rattler.**—Seed from W. E. Collins, Mayersville, Miss. This is a long staple variety, having plants similar to Allen Long Staple. The seed are naked and the per cent of lint averaged 31. The bolls are small (91 per pound), ovate and abruptly pointed, and most of them containing 4 locks. Lint fine and long.

**Blue Ribbon.**—This variety was originated in 1900 by the South Carolina Experiment Station as a result of a cross between Allen Long Staple and Dickson. It is distinctly a semi-cluster variety of the long staple group, but the lint is not quite so long as the standard long staple varieties. The bolls are small to medium in size (averaging 80 per pound), ovate, and pointed, with 5 or 4 locks. The plant is medium to tall, abundantly fruited, compact, erect with short joints, the upper limbs short, the base limbs medium to long. Maturity, early to medium, and the earliest of the long staple group. Per cent of lint 32.8, or one of the highest of the long staples. Seed are medium size. There are two strains of Blue Ribbon differing chiefly in the fact that one has nearly naked black seed; the other, seed covered with white, or brownish white fuzz. Rank in yield of lint at Auburn 24th and 16th. The earliness, compact shape, number of bolls and length of lint make this a promising variety, and the staple should command sufficient premium to make this a competitor in point of profit with the best short staple varieties.

**Bohemian.**—This is a big boll variety from Texas with the characteristic shape of plants of that group. The bolls are very large, 49 making a pound of seed cotton; the per cent of lint is low (32.8); the seed are large, fuzzy, and mostly white. The lint is unusually long for this class of cotton. The plant is large and of pyramidal

shape with rather long limbs. Maturity, late. Bolls ovate and abruptly pointed.

*Borden*.—The high per cent of lint (37.5), small size of bolls (89 per pound), and small size of seed suggest that this may be a member of the Peterkin group. The seed are fuzzy and brownish. Seed were obtained from A. Borden, Goldsboro, N. C.

*Boyd*.—Seed of this old variety were obtained from H. C. Prevost, New Orleans, La. The plant is of medium size, somewhat variable, sometimes approaching the semi-cluster form, and assignable to the intermediate group. The seed are scantily covered with brownish fuzz and resemble Peterkin. Bolls small (82 per pound), 4 or 5 locks, short and roundish, sometimes abruptly pointed and sometimes blunt. Per cent of lint 33.7. Maturity early to medium. Lint, short. This variety is interesting only as being the reputed parent of a number of better varieties.

*Braddy*. (Synonym, Peterkin). This strain was selected by L. C. Braddy, Dillon, S. C., from a variety known locally as Simpson, which was probably Peterkin. The plant has the typical shape of the Peterkin group and has numerous, medium to long, rather slender limbs. In per cent of lint (37.8), small seed, naked or brownish fuzzy seed, this variety appears to be identical with Peterkin, though bolls were smaller (99 per pound) and a somewhat larger proportion of seed was naked in tests made at Auburn. In maturity it is medium. The plant is prolific, the type well fixed. In a publication of the United States Department of Agriculture, the statement is made that the seed are gray, and tufted, and the lint very curly.

*Branch Long Shank*.—M. L. Branch, Bishop, Ga., states that this has also been known under the name of Shank-High. But a comparison of the seed as grown under the first name at Auburn with seed distributed in 1907 by the United States Department of Agriculture suggests that either this cotton is wanting in uniformity or that the two names are not synonyms. The Branch seed are mostly brownish white, while the seed from the Department are mostly white with some greenish seed. The plant is tall, rather poorly supplied with limbs and bolls. The bolls have 4 and 5 locks, and are of medium size (77 per pound). The seed are large and the per cent of lint 33.6. Maturity medium. Lint short to medium.

*Brannon*.—(Synonym, Little Brannon and probably Peterkin). This is apparently a synonym of Peterkin, as indicated by the high per cent of lint, 36.4, small seed, most of them naked, or scantily covered with brownish fuzz. The points in which it differs from Peterkin are the larger size of bolls (72 bolls making one pound of seed cotton), and longer limbs or more straggling form of plant. It might even be placed in the long limb group.

*Braswell*.—(Synonym, Braswell Cluster). Seed was obtained from J. R. Pitt, Racy Mount, N. C. The plants were very variable, there being a few of a semi-cluster type and some long limbed or straggling. The semi-cluster plants had bolls of medium size, me-

dium per cent of lint; seed mostly white, and of medium size, fuzzy. In maturity the plant ranks as medium, and it is rather prolific.

*Breeden.*—Seed were obtained from T. C. Breeden, Lester, S. C. This is a rather tall plant, and seems to have fruit limbs a little longer than in the semi-cluster group; hence it is classed in the intermediate group. The bolls are above medium size (68 per pound), usually with five locks, oval with abrupt point. Storm resistance, good. The seeds are medium size and brownish and whitish brown colors, being of a lighter shade of brown than seed of Gold Standard.

*Brown No. 1.*—Seed was obtained from M. L. Brown, Bremen, Ga. In high per cent of lint (37.7), large size of boll (61 per pound), and in form of plant, which varies between typical big boll shape and tall, short limbed form, this cotton is practically identical with Cook Improved. The seed are a little larger and contain a larger proportion of dark greenish brown seed, the seed from some plants resembling Bancroft. This is a prolific variety of medium maturity.

*Bur.*—Bolls, medium to small, classification uncertain.

*Butler.*—This cotton, from North Carolina, embraced plants of several types. In maturity it ranked as medium. Per cent of lint only 30.4.

*Cameron.*—(Synonym, Cameron Improved). This was originated about 1895 by R. R. Cameron, West Greene, Ala. The parent varieties were Drake "Cluster" and Peterkin. The characteristics of both parent plants are plainly shown in the form of plant, some plants being of characteristic Peterkin shape, others tall with short upper limbs, and still others resembling the big boll type. At present this cotton more nearly resembles the Peterkin than the Drake "Cluster." Its high per cent of lint (36.8), small bolls (92 per pound), and small seeds, which are either naked or covered with brown fuzz, are identical with Peterkin. The bolls are mostly oval or ovate, abruptly pointed, with 5 or 4 locks. Maturity medium, storm resistance medium to poor; rank in yield of lint at Auburn, 7th and 14th. We are justified in assigning this to the Rio Grande group except a minority of the plants which show traces of other ancestry.

*Carolina Queen.*—(Synonym, Peterkin). Seed were obtained from J. C. Fowke, Blalock, S. C., who has selected seed of unknown origin, but which evidently must have been Peterkin. In high per cent of lint (35.8), form of plant, small seed, and the brown fuzzy covering of most seed, this plant resembles Peterkin, but differs from Peterkin only in having nearly all of its seed fuzzy, and in the slightly larger bolls (74 per pound). This may be considered as a fuzzy-seed form of Peterkin, promising because of its larger bolls.

*Champion.*—(See Ptoney and Peterkin.)

*Cheise.*—This unusual name is probably a local designation for a variety of the big boll class from Texas. Bolls are large, seed large and brownish white.

*Cherry Cluster.*—This variety from South Carolina is probably

now extinct. From Alabama Experiment Station Bulletins Nos. 33 and 56 we learn that the plant was of medium size, compact, well limbed and prolific, resembling Peerless, but having longer limbs and joints; bolls small and roundish; seed small, fuzzy; maturity early.

*Christopher*.—This is said to have been originated by R. H. Christopher, LaGrange, Ga., about 1880. In form of plant, size of bolls (only 59 per pound of seed cotton), large size of seed (.135 gram), medium per cent of lint (34.3), and characteristic form of plant, this variety belongs to the big boll group. Most of the plants have the rather low, symmetrical, diffuse growth characteristic of that group. Some of them have rather short upper limbs, forming what may be called the erect type of big boll. The bolls are large (59 per pound), roundish, often blunt, and more frequently contain 5 than 4 locks. Maturity medium. The seed are large, fuzzy, and mostly brownish white, with an occasional greenish white seed. Rank in yield of lint at Auburn, 5th and 12th. This is a prolific big boll cotton, resembling Truitt in most points, but differing from the latter in having a larger proportion of roundish blunt bolls.

*Cleveland*.—J. R. Cleveland, Decatur, Miss., states that he originated this variety about 1885 by selecting seed from a cotton bearing no known name. The plant is tall and is well supplied with bolls and with limbs of medium or short length, tending toward the erect type of big boll plant. The bolls are large, (65 per pound) usually having five locks and falling out easily, this being the chief shortcoming of this variety. The seed are of medium size, fuzzy, brownish white, with some greenish seed. Bolls large, roundish, and pointed or bluntish. This is one of the earliest of the big boll group, ranking as early to medium. At Auburn, it has been one of the most productive of the big boll group, ranking in yield of lint, 3d in 1905, and 3d in 1906, or a little below Cook Improved.

*Cliett*.—Seed were obtained from R. A. Cliett, Harlem, Ga. The plants are mostly of characteristic big boll form, or in some cases of erect big boll form. The bolls are large, (63 to the pound of seed cotton), and roundish. The per cent. of lint averaged 34.8. Maturity medium. The seed are large, fuzzy, brownish white and greenish white.

*Cobweb*.—W. E. Collins, Mayersville, Miss., states that he originated this variety about 1878, using Sea Island and Peeler as parents. It resembles Colthorp and Black Rattler. The plant is tall, open of pyramidal form and is a long staple upland variety. The bolls are small (89 per pound), slender, long pointed, and usually having four locks. This variety has naked seed, of medium size, (.117 gram), the naked seed doubtless coming from the Sea Island parent. The per cent. of lint is 28.8. The lint is long and fine.

*Cook Long Staple*.—(Synonym, W. A. Cook.)

This variety is said to have been originated by W. A. Cook, Newnan, Miss. The plant is medium to tall, of rather straggling or limby form, with long internodes, the plants with best fiber resembling in form Allen Long Staple. Maturity, medium to late. The

**bolts** are of medium size and larger than those of any other long staple tested, except Griffin, 72 bolts averaging one pound of seed cotton. The bolts are ovate, either long pointed or abruptly pointed; per cent. of lint 30.2; seed of medium size, mostly white or brownish white. The fiber is abundant and of long staple, but neither so long nor so fine as that of Allen Long Staple, and Griffin. The seed obtained in recent years has been badly mixed with some short staple variety. This is apparently one of the most productive varieties of the long staple group, having ranked in the tests at Auburn as 1st, 4th, and 24th, in different years.

*J. C. Cook.*—A variety of purple leaf cotton, probably now extinct or represented by some improved descendant, (See Red Leaf.) The writer, who has been unable to obtain any seed under this name, puts on record here data taken from earlier publications of the Alabama Experiment Station. In 1891 this variety was the least productive of 12 varieties tested. Its staple was very short; per cent. of lint 34.5. "Stalk, medium, pyramidal, purple. Leaves purple underneath, presenting a singular appearance. Devoid of wood limbs. Bolts round; staple very short; not prolific; very late."

*Cook.*—(Synonym, Cook Improved.) This variety was originated by J. R. Cook, Ellaville, Ga., in 1895. He believes it to be a natural cross between some early variety and one known locally as Beat All. In form of plant Cook cotton is somewhat variable. About 60 per cent of the plants are tall with short fruit limbs, and few medium length base limbs. The remaining plants are mostly of the diffuse big bolt type with fruit limbs medium to long. The bolts are large, (66 making a pound of seed cotton), roundish, often blunt, with usually five locks. The seed cotton falls out easily, which is the point of greatest weakness in the variety. In maturity, Cook is early to medium, ranking with Cleveland and Berry Big Bolt as the earliest varieties having large bolts. The bolts open well and are easily picked. The per cent of lint is very high, the average at Auburn being 38.9 per cent. This has been one of the most prolific varieties both at Auburn and at other stations. Its rank in yield of lint at Auburn during the past three years has been 6th, 2nd, and 1st. Its productiveness, large size of bolts and extremely high per cent of lint have brought this variety recently into deserved popularity.

*Colthorp.*—(Synonyms, Colthorp Pride, Laclede, Colthorp Black Rattler.)

Seed was obtained from Colthorp & Co., Talla Bena, La., who state that this cotton originated about 1902 from a few locks of cotton of unknown origin, having black seed and good length of staple. This is a long staple variety but as grown at Auburn the staple was not quite as long as Griffin and Allen. This cotton very closely resembles Black Rattler and Cobweb in form of plant, small size of bolts (98 per pound), naked black seed, and in character of lint. Per cent. of lint averaged for three years 33.6.

*Colthorp Eureka.*—(See Keno.)

*Combination.*—R. Bates, Jackson, S. C., states that he originated

this variety. It has a high per cent of lint (38.8) , small, fuzzy, brownish seed, and a plant similar to Peterkin. Although the plant bears many bolls, their small size, (97 to the pound of seed cotton), makes this variety worthless. This is believed to be a strain of fuzzy seed Peterkin.

*Coppedge*.—Seed were obtained in 1899 from C. S. Coppedge, Nysen, Ga. This is a big boll variety (65 bolls per pound) with large, fuzzy, brownish white seed. The storm resistance is fair; maturity medium.

*Corput*.—(Synonym, Corput Find.) This cotton as grown at Auburn for two years was too badly mixed to be described. It contained plants that could not be distinguished from Jackson, and others similar to Peterkin.

*Crossland*.—(Synonyms, Peterkin, Carolina Queen, Moss, Texas Wood, etc.)

In form of plant, size and shape of boll, in small seed, and in appearance of seed, which are partly naked and partly covered with a scant brown fuzz, we have not been able to find any difference between this cotton and the Peterkin variety. When tested in field plots at Auburn, its average rank in yield of lint was about the same as that of Peterkin.

*Crawford Peerless*.—(See Peerless).

*Culpepper*.—(Synonym, probably Wyche.) J. E. Culpepper, Lumpkin, Ga., states that he originated this variety about 1892, using Wyche and Dickson as parents. It is now exactly similar to Wyche and shows no trace of its alleged Dickson parentage, and should probably be regarded as a selection from Wyche. In form of plant this variety is typical of the big boll group, being rather low, spreading, and having limbs of medium length. The bolls are large, (63 making one pound of seed cotton), ovate, rather blunt pointed, opening well and having very poor storm resistance. There are variously five and four locks. The per cent. of lint averaged 34.7. The seed are large and covered with a dense fuzz. Most seed are brownish white, or white, with a small proportion that have a greenish tinge. Maturity, medium, or earlier than most big boll varieties. Lint, short to medium. The plants are prolific for a big boll variety. In plot tests at Auburn Culpepper ranked about midway from top to bottom of list.

*Cummings*.—This is a local name in the eastern part of Alabama for a variety once quite popular and regarded as productive. It is now little grown or entirely extinct in its pure form. It is said to have been especially subject to boll rot, which is assigned as the cause of its disappearance. As grown at Auburn the plant was of medium height, and of semi-cluster or nearly semi-cluster type. The bolls are of medium size, (78 per pound), ovate, abruptly pointed; maturity, early to medium; storm resistance poor; seed fuzzy, medium size, mostly brownish white.

*Davis Long Staple*.—This is a long staple, rather short jointed variety. The plants are rather prolific; the staple long and fine; ma-

turity, almost as early as any of the long staples; bolls small and tapering.

*Dearing*.—(Synonyms, Dearing Prolific and Dearing Small Seed.)

A variety apparently but little grown now. As grown at Auburn this was rather an unpromising variety of uncertain classification. Some plants were of the semi-cluster form and others were somewhat similar to Peterkin. Seed, small, fuzzy, brownish. Per cent. of lint only 31.5, although it is stated that once this variety had a high per cent of lint. Lint, short to medium. Maturity, medium.

*Defiance*.—(Synonym, Drake Defiance, and probably World's Wonder.)

Seed obtained from Drake Brothers, Philomath, Ga., who introduced the variety within the past few years. This is a prolific, semi-cluster, well fruited cotton, with small bolls. The plant is tall, well shaped, with short upper limbs and medium to long base limbs, resembling Woodfin and Hardin. The bolls are small, 92 average bolls being required in our test to yield one pound of seed cotton. The bolls are ovate, abruptly pointed and more frequently containing five than four locks. The per cent of lint is 34.2; seed small to medium, fuzzy, and mostly brownish white and greenish white. In maturity Defiance is early but not equal to King. The Drake cotton from Alabama has the first right to the name Drake, by reason of priority of use.

*Diamond*.—(Synonym, Diamond Six Lock). This is a big boll variety with low per cent of lint. Large, brownish, fuzzy seed. The lint is above medium in length; the large, roundish bolls contain mostly five locks and occasionally six locks; maturity, medium to late.

*Dickson*.—(Synonyms, Dickson Cluster, Dickson Improved, Dixon and Simpson). David Dickson, of Oxford, Ga., whose agricultural writings have so strongly influenced Southern agriculture, originated this variety about 1857 or 1858, by continuous selection from Boyd Prolific. This typical cluster variety was once very popular, but is no longer a general favorite. The plant is slender, erect, with numerous very short fruit limbs and several medium to long base limbs. The bolls are numerous and closely clustered. The small size of bolls (104 per pound of seed cotton) constitutes its greatest fault. The seed are small, fuzzy, mostly brownish white, and occasionally greenish white. The lint is short to medium. Most plants mature early, though not so early as King. The small bolls are ovate to roundish, and often blunt. The per cent of lint is low (32.3.) In 1905, in our variety test, boll rot destroyed more than half the bolls of Dickson, while adjacent varieties suffered only to medium extent. It was not then possible to determine whether this was due to the use of badly infected seed or to an inherent weakness in the variety. In three field tests at Auburn it ranked near the bottom of the list, and in two tests near the top of the list.

*Dirie Wilt Resistant*.—(Synonyms, U. S. Dept. Agriculture No. 148 and Orton No. 148). This variety is the result of successful at-



tempts to develop a variety of cotton that should be resistant to cotton wilt, also called "black heart" and "black root." Credit for originating it is due W. A. Orton, of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., who in 1901 saved seed of plants growing on the farm of M. C. Scott, near Montgomery, Alabama, that were resistant to this disease. The name of the variety from which selections were first made is unknown. Mr. Orton thinks that the Dixie is the result of accidental hybridization between this original selection and other cottons grown with it the following year. Each year it has been grown by him on infested land and seed has been saved from plants that resisted cotton wilt. While more immune than any other variety tested in comparison with it, it is not yet entirely proof against wilt, especially on land badly infested with both wilt and nematodes, or root knot worms. The plants are of medium size, having numerous medium length branches and resembling Peterkin, from which, however, it differs in having a very low per cent of lint. The bolls are small, ovate or roundish and pointed. There are more frequently five than four locks; storm resistance is medium to good. The per cent of lint averaged 33.1. The seed are small (averaging .107 gram). The seed are variable, the fuzzy brownish seed being those preferred by the originator. Some plants have seed many of which are partially or entirely naked and exactly like Peterkin. Small green or greenish seed also occur. Lint is of medium length. In maturity this plant is medium to late. There is need for improvement in yield of lint, per cent of lint, size of bolls, uniformity of seed, and lower position of first limbs.

*Double Header*.—Seed were obtained in 1906 from R. H. Smith, Monticello, Ga. This is a promising big boll variety unusually well supplied with limbs and bolls. The leaves resemble Russell in size and shape. The seed also are similar to Russell and Bancroft Herlong, being very large, fuzzy, deep green and brownish green. The bolls are very large, (only 47 being required to make a pound of seed cotton as compared with 62 in the Russell variety). This evidently belongs in the Russell or Bancroft sub-division of the big boll group, but is apparently an improvement on both. The bolls are ovate, tapering and usually contain five locks; the bolls turned down, the seed cotton hanging together and showing medium storm resistance. The parts of the bur curl up. The per cent of lint is medium, 34.1; lint medium length; maturity, medium or medium to late. This variety has not yet been tested by us in such a way as to determine the yield of lint per acre.

*Dongola*.—(Synonyms, probably Haraldson, Montclare, Rogers and perhaps Lealand). Seed were obtained from B. F. Malabar, Waynesboro, Ga. This is a big boll variety approaching a semi-cluster, and very similar to Montclare and Rogers. The plant is tall with base limbs of medium length and short fruit limbs well supplied with bolls. It is short jointed and rather slender. The bolls are large (63 per pound), roundish, and often blunt. The seed are

large, fuzzy, and mostly brownish white. The per cent. of lint is high for a big boll variety (36). In maturity, Dongola ranks as late. The lint is of medium length.

*Doughty*.—(Synonym, Doughty Long Staple). We have grown this variety for five years, and have found it badly mixed. Some of the plants have the characteristic long staple form, and others more nearly resemble the big boll and straggling plants. The best type of plants have fiber scarcely long enough to admit this cotton to the long staple class, and on most plants it is plainly short staple fiber. The bolls are medium size (75 per pound), ovate, and long pointed, containing four or five locks. The seed are large, fuzzy, mostly brownish white. The plant is well supplied with bolls, and in maturity ranks as medium to late. In one plot test at Auburn, Doughty ranked tenth in yield of lint.

*Doughty Big Boll*.—This name has apparently been used incorrectly as a synonym for Doughty.

*Dozier*.—(Synonyms, Dozier Improved and King). This cotton from North Carolina has plants that resemble the larger specimens of King. In size and character of bolls, seed and lint, and even in the red spots on the petals, we were unable to see any difference between this and King, except that the Dozier cotton was less uniform.

*Drake*.—(Synonyms, Drake Improved and Drake "Cluster.") This variety is the result of selections made by R. W. Drake, Laneville, Alabama, probably from the Peerless variety. In form of plant most plants clearly belong in the big boll group, while others approach the semi-cluster type. However, the word "cluster" is misleading, for this variety is not even a semi-cluster, though well supplied with bolls. The bolls are large (64 per pound), oval, abruptly pointed and only occasionally bluntish. The seed are large, fuzzy, mostly brownish white and greenish white. Lint of medium length. This variety is entirely different from Drake Defiance.

*Drake Defiance*.—(See Defiance).

*Duncan*.—This old variety from Georgia is now nearly or quite extinct. In shape it resembles Jones and other typical big boll varieties. The bolls are large (64 per pound), ovate, or oval, and abruptly pointed or blunt, usually with 5 locks. The per cent. of lint is low; the seed are very large, fuzzy, mostly whitish brown and greenish white. In plot tests at Auburn it ranked one year at the bottom of the list and two years about midway of the list in yield per acre. In maturity it is medium to late. Lint medium in length.

*Early Gayosa*.—(See Gayosa).

*Eclipse*.—(Synonym, Eclipse Long Staple). This variety, grown here in 1902 had all the characteristics of a long staple cotton, except that it was deficient in the length of lint. This may have been due to the very dry summer which that year reduced the length of staple of most long staple varieties. The bolls and seed are small (93 bolls per pound), the seed fuzzy, and mostly brownish white.

*Edgeworth*.—(Synonyms, Little and Little Improved). This cotton was introduced by J. C. Little, Louisville, Ga. This variety is

difficult of classification, and is probably best assigned to the intermediate group. The plant is tall and limbs are short to medium. The bolls average medium size (69 per pound), and usually have 5 locks. The seed are fuzzy, small, mostly brownish white and greenish white, resembling King. The per cent of lint is 35.7. This is a well balled plant of early to medium maturity. In the only plot test at Auburn it took low rank in yield of lint per acre.

*Ellis*.—(Synonym, *Ellis Big Boll*). Seed were obtained from G. B. Ellis, Palmetto, Ga. This is apparently a big boll variety with some plants approaching the long limbed type. The bolls are large (59 per pound), ovate, and abruptly pointed. The seed are large, fuzzy, mostly brownish white and greenish white. The per cent of lint is 32.1.

*Eureka*.—Seed were obtained from S. L. Thornton, Hartwell, Ga. Apparently this name has been applied to several different kinds of cotton. The per cent of lint of this short staple variety is high (38.6); bolls small (95 per pound), roundish; seed small and fuzzy, mostly brownish white. The variety seems to be intermediate between King and Peterkin.

*Excelsior*.—The cotton grown at Auburn under this name is the one originated by C. F. Moore, Bennettsville, S. C. The same name according to S. M. Tracy, has been applied to a selection from New Era, made in Georgia. The plant is similar to Peterkin, as also are most of the qualities of seed, except that there are no naked seed. The seed are small, fuzzy, densely covered with a brownish fuzz, but averaging a lighter shade of brown than the seed of Gold Standard. The per cent of lint, which in our first test was 32.8, has steadily risen to 38.1, probably due to careful selection by Mr. Moore. The bolls are small (95 per pound), oval, short, pointed. This is a prolific early to medium variety of the Rio Grande group.

*Extra Early*.—Seed were obtained from J. B. Crouch, Wedgefield, S. C. The plants were variable, the best being of semi-cluster type, and resembling Woodfin. The bolls are small, oval, mostly blunt. The per cent of lint is above medium. Seed small, fuzzy, brownish white.

*Favorite*.—Seed were obtained from S. G. Mayfield, Denmark, S. C. The form of plant, high per cent of lint, small size of bolls (78 per pound), small size of seed, and appearance of seed of many plants suggests that that is a strain of Peterkin with practically all the seed fuzzy, and mostly brown. The admixtures somewhat resemble King.

*Ferguson*.—This was received as a long staple variety, but as grown at Auburn the lint was not long enough to admit this to the long staple class. Occasionally plants were found that were practically lintless, the seed being naked and the boll almost entirely devoid of lint. The bolls are small and pointed (87 per pound). Per cent of lint 31.1; seed brownish white.

*Featherstone*.—Seed were obtained from J. A. Collins, Jackson, Ga. This is a variety having some plants that are quite or nearly

of the semi-cluster type, and others with longer upper limbs. The base limbs are long and too far from the ground. The bolls are of medium size, ovate, mostly with sharp points. This variety showed considerable ovate resistance. Seed of medium size, mostly whitish.

*Florodora*.—L. A. Stoney, Allendale, S. C., states that this variety was originated by him in 1900, and that the parent varieties were Sea Island and a prolific upland cotton of unknown name. This variety has been very popular in the eastern section of the cotton belt within the past few years. The plant is tall, usually well shaped, and having the characteristic size and shape of the long staple group. The bolls are ovate and pointed and of medium size (averaging 76 per pound), and have either four or five locks. The seed are of medium size, fuzzy, white or brownish white. The per cent of lint, as usual with long staple varieties, is low (31.3). In maturity *Florodora* is late. The staple is long and fine on most plants, and usually commands a considerable premium over ordinary upland. Growers of this variety in this county in 1906 received a premium of 4 to 5 cents per pound, and still higher premiums have been obtained elsewhere. Where the local markets offer no premium, long staple cotton must be shipped to the seaport markets. In our field tests at Auburn, *Florodora*, like other long staple varieties, ranked near the bottom of the list in yield of lint per acre.

*Garrard*.—(Synonym, probably *Hawkins*), Seed were obtained from P. R. & W. T. Garrard, Nona, Ga. This is a semi-cluster cotton which in appearance of plant, per cent of lint, medium size of boll, medium size of seed, and appearance of seed was indistinguishable from *Hawkins*. Seed are mostly brownish white with occasionally a shade of green. The variety is early to medium, and prolific.

*Gayosa*.—(Synonyms, *Early Gayosa* and *Gayosa Prize*). This cotton of uncertain classification—a part of the plants probably belonging in the Rio Grande, and part in the short limbed groups—was notable in our tests for its low per cent of lint. Bolls are small (71 per pound.) Some of the plants had naked seed like *Peterkin*.

*Gholson*.—(Synonym, *Allen Long Staple*). This is a selection from *Allen Long Staple* made by L. K. Gholson, Fort Deposit, Alabama. This cotton is similar in all respects to *Allen Long Staple*, which see.

*Gold Dust*.—(See *King*.)

*Gold Standard*.—Seed were obtained from *Excelsior Seed Farm*, *Bennettsville*, S. C. This variety is of doubtful classification, for it contains plants that in turn suggest the semi-cluster, the Rio Grande and the *King* group. Generally it is a rather compact, erect, almost semi-cluster plant with base limbs of medium length. The bolls are small to medium (77 per pound), mostly roundish. The per cent of lint is high (36.1); maturity, medium. This is a rather prolific variety, the most distinctive feature of which is the deep brown or yellowish brown color of fuzz, which densely covers the seeds of many plants.

*Grayson*.—(Synonyms, *Grayson Big Boll*, *Grayson Early Prolif-*

ic). Classification doubtful; bolls medium to large; low per cent of lint. Seed are large, mostly brownish white.

*Gregg*.—This variety is stated to have been originated about 1900 by S. A. Gregg, Florence, S. C., from a single plant found in a garden. The plant somewhat resembles Peterkin, but the fuzzy seed, mostly brownish white and greenish white, make the classification of this variety doubtful. The bolls are of medium size, mostly ovate and pointed. The per cent of lint is high.

*Grier*.—(Synonyms, *Grier's King* and *King*). Seed were obtained from L. F. Grier, Oxford, Alabama. This cotton was identical with *King* in all respects, including the red spot at the base of each petal.

*Griffin*.—(Synonym, *Griffin Long Staple*.) This long staple variety was originated by the late John Griffin, Greenville, Miss., about 1867 as the result of repeated crossing between *Sea Island* and the *Old Green Seed*. Selection has been continued each year since then by the originator or by his son. At present selection is being made with a view to fixing the 5-lock quality, while maintaining the length and fineness of fiber. As grown at Auburn, the *Griffin* plant was not prolific. The lint is longer and finer than that of any other upland variety tested by the writer, but the fiber lacks uniformity of length; even the shortest fibers are full long for the long staple class. The staple is weak, and the outer part of the lock has often a characteristic glossy sheen. Maturity, late; bolls medium to large, and larger than any other long staple (66 being required to make one pound of seed cotton). Locks 4 and 5; per cent of lint, 31.7. Seed mostly brownish white or whitish brown; medium size.

*Griffin Drought Proof*.—This short staple variety from Georgia, is different from *Griffin Long Staple*. Per cent of lint low.

*Gunn*.—Seed were received from C. L. Gunn, Temple, Miss. This is a large plant of the *Petit Gulf* or long limbed type, though it might equally well be ranked as a large spreading form of the big boll group. The bolls are large (65 per pound), oval, abruptly pointed. The seed are fuzzy, mostly white, but with some mixture of deep green seed. Per cent of lint 32.1.

*Hagaman*.—Prof. H. J. Webber states that this variety originated near Jackson, La., and was probably a selection from one grown under the name of *Dean*, though *Peeler*, which it resembles, was the kind grown almost exclusively on the owner's plantation at the time. The form of plant varies somewhat, and is nearer to the long limbed than to any other group. Bolls small (85 per pound), ovate, pointed; seed small and on some plants brownish white and on others partly naked. Per cent of lint 34.3.

*Haralson*.—(Synonym, *Dongola*, which see.)

*Hardin*.—Originated by B. B. Hardin, Washington, Ga., who exhibited at the Macon Fair in 1906 single limbs almost completely hidden by the thickly clustered open bolls. Receiving no reply to letters addressed to the originator, we secured our seed through a firm in Montgomery, Alabama. As grown here in 1906, *Hardin* was

a semi-cluster variety very similar to Woodfin and Sterling, but not bearing bolls in dense masses. The bolls were numerous and from medium to small in size (77 per pound of seed cotton), and the per cent of lint 30.3. The small seed are partly white and partly greenish white.

*Hawkins*.—(Synonyms, Hawkins Improved and Hawkins Jumbo). Originated by W. B. Hawkins, Nona, Ga. This is a standard semi-cluster variety, and the plant is usually prolific and of good shape. The medium to small bolls (79 per pound) are often roundish. The per cent of lint is 34.6. The seed are fuzzy, mostly brownish white and greenish white. Maturity, early to medium; lint, short to medium in length. In plot tests at Auburn it ranked in yield of lint 9th, 16th, 8th, 3rd, 3d, 15th, 8th, and 7th.

*Hawkins Jumbo*.—(See Hawkins.)

*Herlong*.—A variety entirely different from Bancroft was tested once. It had small bolls and small seed. (See also Bancroft.)

*Herndon*.—(Synonym, Herndon Select). This is a selection made by J. A. Herndon, Elberton, Ga., from an accidental stalk resembling the Dickson. The Herndon is almost a semi-cluster variety, with small bolls (85 per pound); small brownish white seed; and early to medium maturity. Per cent of lint 33.1.

*Hodge*.—(Synonyms, King and probably Dozier). This cotton from North Carolina has medium to small bolls; early maturity; small greenish white and brownish white seed. In form, the plant somewhat resembles the larger plants of King.

*Hilliard*.—This is a semi-cluster variety very near to the big boll class, with medium to large bolls (69 per pound); per cent of lint, 34.6; rather broad semi-cluster form of plant; medium size of seed, fuzzy, and chiefly brownish white. Maturity early to medium.

*Holloway Storm Proof*.—(Synonyms, Storm Proof and probably Rowden). A big boll large seed variety.

*Hunnicutt*.—(Synonym, Hunnicutt Choice). This was a variety originated by the late Dr. J. B. Hunnicutt, of Georgia, who several years ago wrote me that he believed the variety then to be extinct. This was a variety with medium to long limbs; bolls medium size, fuzzy, roundish, brownish white seed.

*Hunnicutt Big Boll*.—(Synonyms, probably Russell and Bancroft). The plants are similar to Russell. This cotton has recently been selected by J. A. Hunnicutt, Warsaw, Alabama. The bolls are very large, the seed large, fuzzy, brownish green and deep green, exactly resembling Russell, from which it is probably a selection. The per cent of lint is low and maturity late.

*Hutchinson*.—This big boll variety was obtained from J. N. Hutchinson, Salem, Ala. The bolls are large, ovate, abruptly pointed, showing considerable storm resistance. The seed are fuzzy, medium size, mostly brownish white with some greenish white.

*Improved Long Staple*.—This is in the long staple group with small bolls, fuzzy, brownish white, medium sized seed.

*Jumbo*.—(Synonym, Hawkins.)

*Jackson*.—(Synonyms, African and Limbless.)

This variety, which a few years ago was largely exploited, is a tall, cluster cotton, resembling Welborn Pet, but having larger bolls, and lint adhering to the burs more firmly. The bolls are mostly borne in clusters near the main stem. There are usually one or two medium to long base limbs, but these are sometimes wanting and sometimes more numerous. The bolls are small, (82 per pound), ovate, tapering. Per cent of lint high, (38); seed fuzzy, small, mostly brownish white. At Auburn it ranked in yield of lint 1st, 3rd and 17th. This is a productive variety but with serious faults of form, height, tendency to shed and difficult to pick.

*Jackson Wilt Resistant*.—(Synonym, U. S. Dept. of Agriculture, No. 128.)

This is the result of selections made since 1900 by W. A. Orton, of the U. S. Department of Agriculture, from plants of the Jackson variety that withstood cotton wilt. It is resistant but not entirely immune.

*Japan*.—This big boll variety with large, fuzzy, white seed was obtained from a Texas seed firm and is probably a local name for some better known Texas variety.

*Johnson*.—(Synonym, Johnson Excelsior.)

This cotton is wanting in uniformity of type, containing plants resembling Peterkin, others like the big boll group, and some of semi-cluster form. The bolls are small, 81 per pound; the per cent. of lint high, (37.7); the seed small, fuzzy, and varying in color from pure white to a yellowish brown.

*Jones*.—(Synonyms, Jones Improved, Jones Re-Improved, and Schley.)

This is a standard big boll variety originated by J. F. Jones, Hogansville, Ga., probably from Duncan. The bolls are large, requiring 62 bolls per pound of lint. The bolls are pointed; the large seed are mostly white, also brownish and greenish white. Per cent. of lint, low. Maturity late. In seven years' tests at Auburn it was usually below the middle of the list and never higher than fifth in yield of lint.

*Jones Long Staple*.—This long staple is described as having a large, straggling, non-prolific, late plant, with large tapering bolls; large, fuzzy, brownish white seed. Staple long; per cent of lint very low.

*Keith*.—Tested at Auburn prior to 1894 and reported in Bulletins Nos. 33 and 56 as a prolific, short limbed, and apparently semi-cluster variety, with roundish bolls of medium size; seed of medium size, fuzzy, white or brownish white; maturity early; per cent. of lint, low; staple short.

*Keno*.—This is a selection made from Colthorp Eureka about 1895 by Colthorp & Co., Talla Bena, La. In form of plant and silkiness of staple it probably belongs in the long staple group, but as grown at Auburn the lint was of scant length for long staple. Bolls are

very small, (104 per pound); per cent. of lint, (32.4); seed fuzzy, small, mostly brownish white.

**King.**—(Synonyms, King Improved, Gold Dust, Tennessee Gold Dust, King No. 2, King No. 3, Grier, Mascot, Hodge, Dozier, etc.)

This very distinct variety was originated in Louisburg, N. C., by T. J. King, about 1882-4, from several plants selected by him as superior to the parent varieties, which latter he declines to name. The King in form of plant is taken as a distinct group, with plants characterized by small size, short base limbs, numerous medium length upper limbs, the longest of which are sometimes crooked, the growth reminding one of the limbs of a black jack oak (*Quercus Marylandica*.) On part of the blooms there is a red spot inside the flower and near the base of each petal. The most valuable quality of this variety is its extremely early maturity. We have found no other so early. This makes it a favorite in regions where the boll weevil is present. Its popularity on this account is somewhat offset by the small size of bolls and by the shortness of staple. The per cent. of lint is high, almost equalling the Peterkin group. The seed are small, fuzzy, mostly greenish white and brownish green. The bolls are roundish or ovate, sometimes blunt. The seed cotton falls out easily. Occasional plants are found of large size, but in other respects these retain the characteristics of the King variety. In 8 years' plot tests at Auburn it was usually about the middle of the list and never above fifth in yield of lint per acre.

**Layton.**—A selection made by R. D. Layton, St. Matthews, S. C., from a mixed cotton. In form of plant, high per cent. of lint, (39), medium to small size of bolls, (76 per pound), and small size of seed, this variety belongs in the Rio Grande group, but it differs from Peterkin in that practically all of the seed are fuzzy. Most of them are brown or brownish white, some greenish white, the darker seed resembling the fuzzy seed occurring in the Peterkin variety. Like Peterkin, Layton has but slight storm resistance. There are usually five locks. Layton is medium in maturity and has proved at Auburn one of the most productive of the Rio Grande group, ranking in yield of lint per acre, second, fifth and second, among all varieties tested in plots in 1904, 1905, and 1906, respectively.

**Langford.**—Seed from S. J. Langford, Albin, Ga. This is a big boll variety. The plants are short jointed and approach the semi-cluster form, and are medium in maturity. The seed are fuzzy and small to medium; per cent. of lint 35.1. Bolls, 63 per pound.

**Lealand.**—Seed from H. P. Jones, Herndon, Ga.

This is a semi-cluster variety with roundish, mostly blunt bolls, above medium size, (70 per pound.) The seed are large, fuzzy, mostly brownish white and greenish white, but in some plants resembling Bancroft. In maturity Lealand is medium; per cent. of lint, 33.6. Although the plants are of pleasing shape and fairly well balled, yet in a single test here Lealand ranked at the bottom of the list in yield of lint per acre.

**Lee.**—Seed from E. E. Lee, Wildwood, Alabama. This is probably



a local name. It represents a big boll variety with ovate, pointed bolls; large, fuzzy, brownish white and greenish white seed.

*Lewis*.—(Synonyms, Prize, Lewis Prize.)

W. B. F. Lewis, Lewiston, La., states that he originated this variety. This is a plant of the erect, short-limbed type, with few short base limbs, or none, and characterized by some plants having near the base crooked fruit limbs, curving downward and bearing four, five, or more bolls. The photograph represents a plant of this type without base limbs. The bolls are medium to small, (78 per pound), ovate or roundish, pointed. The seed are fuzzy, small, mostly brownish white, and greenish white, the brownish seed resembling those of Layton. The per cent. of lint is 35.8. The fibre is rather short. In a single plot test at Auburn it stood just above the middle of the list in yield of lint per acre.

*Limbless*.—(See Jackson.)

*Little*.—(See Edgeworth.)

*Laclede*.—(See Colthorp.)

*Louisiana*.—This cotton from Louisiana is a large, straggling, long limbed plant with small bolls. It is a late variety and probably belongs in the Petit Gulf group.

*Lowry*.—Seed originally from J. G. Lowry, Cartersville, Ga. This is an early variety similar to King. The bolls are small, (79 per pound); the seed are medium size, mostly greenish white and brownish white. Per cent. of lint 33.1.

*Maddox*.—Seed obtained from J. S. Maddox, Orchard Hill, Ga. This is a big boll variety with fuzzy seed, some of which are greenish white and some brownish, the latter with only a scant covering of fuzz. It has large, ovate, pointed bolls, (63 per pound), large seed, per cent. of lint 34.9; maturity medium.

*Mascot*.—In all respects this proved identical with King, which see.

*Matthews*.—(Synonym, Matthews Long Staple.) This Mississippi variety, now nearly or quite extinct, is nearer to the big boll than to the long staple class. The lint is too short and the bolls too large for the long staple group. The bolls average 67 to one pound of seed cotton. The seed are large, fuzzy, white; maturity medium. Per cent. of lint 31.4.

*Mattis*.—Seed from C. F. Mattis, Learned, Miss. The plant was similar to Peterkin, but perhaps larger. The bolls are medium in size, (77 per pound), oval, pointed, with slight storm resistance; maturity medium; seed are small, black and naked. This seems to be a rank growing form of Peterkin with lower per cent. of lint, (32.4.)

*Parker*.—This cotton was originated by John M. Parker, Sr., in Bolivar County, Miss., about 1868. This belongs in the Rio Grande group as judged by form of plant, size of boll and size of seed. It differs from Peterkin in having somewhat more fuzz on the dark brown to brownish white seed, and in having a lower per cent of lint, 33.1. The bolls are small to medium, (75 per pound), ovate, and slightly pointed. The seed are small to medium; maturity medium.

At Auburn, Parker was less productive than Peterkin and had slightly longer limbs.

*Mebane*.—(Synonyms, Mebane's Triumph; Triumph, which see.)

*Meredith*.—(Synonym, Meredith Big Boll.)

Seed from J. C. Meredith, Jenkins, Ga. This variety can probably be classed as belonging to the intermediate group. The plant has one to three short base limbs, is medium to tall, and has ovate, pointed, medium sized bolls, (72 per pound). The seed are medium sized, mostly brownish white and greenish white. The per cent. of lint is 32.8; maturity medium. In a single plot test at Auburn it stood near the bottom of the list in yield.

*McCall*.—This is a semi-cluster variety of no conspicuous merit from South Carolina. The bolls are of medium size, (71 making a pound of seed cotton), ovate or roundish, and pointed. The per cent. of lint is 34.4; the seed are of medium size, fuzzy, mostly brownish white.

*Minor*.—Seed from J. J. Minor, Toombsboro, Ga. This is a semi-cluster variety, with rather long upper limbs for this group. The bolls are of medium size, (74 per pound of seed cotton), the per cent. of lint 34.4; seed of medium size, fuzzy, brownish white, brownish, and greenish. Maturity medium to late.

*Missionary*.—(Synonym, probably King, which see.)

The plants, though lacking in uniformity, resemble the larger plants of King and other qualities also accord with those of King.

*Mitchell*.—(Synonyms, Mitchell Twin Boll and Clark Prolific.)

H. B. Mitchell, Athens, Ga., states that he originated this variety about 1895. The classification of this variety is uncertain. Bolls are medium to small, (79 per pound); the seed medium in size, fuzzy, brownish white and brown.

*Montclare*.—E. M. Williamson, Montclare, S. C., states that this variety was originated by him about 1891, probably as a selection from Jones Big Boll. This rather promising variety belongs both in the big boll and in the semi-cluster groups, and closely resembles Dongola and Rogers. The bolls are large, (65 per pound); roundish, often blunt, and usually contain five locks. The per cent. of lint is high for a big boll variety, averaging 36.8. Maturity, late.

*Moon*.—(Synonym, Moon Long Staple.) In form of plant this variety from Arkansas resembles most long staple varieties. In our test the length of lint was not quite sufficient to place this in the long staple group. The bolls are small, (83 per pound), the seed small to medium, fuzzy and white. Per cent. of lint 32.7.

*Moss*.—(Synonyms, Moss Improved, Peterkin, etc.)

This is a selection from Peterkin made since 1887 by B. D. Moss, Norway, S. C. This cotton could not be distinguished from Peterkin in size and appearance of seed, bolls and plants.

*Mortgage Lifter*.—It required 58 bolls of this big boll variety to make one pound of seed cotton. The bolls are ovate to roundish, and pointed. The seed are large, fuzzy, mostly white, with some brown.

ish white and some greenish white. The per cent. of lint is 34.4; maturity, late; lint, medium to long.

*Nancy Hanks*.—This cotton, which lacks uniformity, is of doubtful classification. Some plants resemble the short limbed group, others the big boll group. The bolls are small; seed mostly fuzzy, and brownish white; per cent. of lint, 35.6.

*New Century*.—The form of plant resembles the long staple group, but the lint, though long for a short staple, was on our dry soil, too short for a long staple. The bolls are small to medium, ovate pointed, with usually 4 locks. The seed are medium to large, white and brownish white. Per cent. of lint medium; maturity medium to late.

*Nonpariel*.—(Synonyms, Woodfin, Woodfin Nonpariel, Sam Woodfin Prolific. See Woodfin.)

*Norris*.—Seed from H. H. Steiner, Grove Town, Ga. This is a semi-cluster variety with small bolls and a very low per cent. of lint. Seed are large and mostly brown and greenish brown. Maturity, medium to late.

*Okra*.—(Synonyms, Okra Leaf, Forked Leaf.) Now probably extinct. It is characterized by leaves having very narrow lobes, thus making the foliage surface relatively small. Limbs, long; length, between joints, medium; bolls small and tapering; seed of medium size, fuzzy, white; staple short; "Prolific for a long limbed variety."

*Orton*.—Nos. 128, 145, 149. (See U. S. Department of Agriculture.)

*Orton*.—No. 148. (See Dixie Wilt-Resistant.)

*Ozier Long Staple*.—(Synonyms, Ozier, Ozier Silk, Ozier Starnes, Tennessees Silk, Bob Silk, Bob White, Bob.)

Seed from J. D. Ozier, Corinth, Miss. This is a rather prolific variety of the long staple class. The bolls are small, ovate, and long pointed, with 4 locks. The staple is long and fine, but shorter than that of Allen Long Staple. Seed small to medium, fuzzy, white and brownish white; per cent lint low. Maturity medium.

*Ozier Big Boll*.—Seed from J. D. Ozier, Corinth, Miss. The seed received under this name produced somewhat variable offspring, most plants belonging in the big boll group, with roundish bolls, often blunt, and usually five locks. Seed fuzzy, large, mostly white, brownish white and green. Per cent. of lint medium; maturity, late.

*Parks Own*.—Seed from G. F. Parks, Alexander City, Alabama. A local name given to a strain of fuzzy seeded Peterkin, that is no longer kept distinct.

*Peeler*.—Described in Alabama Experiment Station Bulletins Nos. 33 and 56 as a large, straggling, non-prolific, late variety, with long, drooping, long jointed limbs; medium to large, tapering bolls; seed large, fuzzy, brownish; per cent of lint, low.

*Peerless*.—(Synonyms, Crawford Premium, Crawford, etc.) This variety, once popular, is now rarely grown. This variety belongs in the semi-cluster group. The bolls are of medium size, ovate, abruptly pointed, with slight storm resistance. Seed are fuzzy, large, and

variable in color, mostly a brownish white. Per cent of lint, 33.4; maturity, medium.

*Petit Gulf*.—This very old variety, now probably almost or quite extinct, belongs in the long limbed group. The plant is large, straggling, long jointed, with slender limbs, often turning downward from the weight of bolls. As we grew it in 1899 and 1903, probably in mixed condition, the variety was practically worthless. The bolls are small, mostly ovate, and either abruptly pointed or obtuse, having both 4 and 5 locks. The seeds are of medium size, mostly fuzzy, greenish and whitish brown. Some of the small fuzzy seed are green. Maturity, late; lint, long for a short staple; per cent lint, 31.8.

*Peterkin*.—(Synonyms, Audrey Peterkin, Brazier Peterkin, Crossland, Carolina Queen, Moss, Peterkin Limb Cluster, Texas Wood, Wise, etc.) This widely grown variety was originated by J. A. Peterkin Fort Motte, S. C., about 1870. As the result of continued selection by the originator, it is now one of the most uniform of all varieties. Plants are of medium to large size, abundantly supplied with branches, which are usually straight; base limbs numerous, and short to medium in length; upper limbs medium to long. The bolls are of medium size (averaging 76 per pound of seed cotton); ovate, pointed, opening wide, usually with five locks, which rather easily fall out. Maturity medium. The seed are small, more than half of them naked and black, except for a tuft of fuzz at the smaller end. The other seed are scantily covered with brownish fuzz. This variety is characterized by a rather high per cent of lint. Lint is above medium in length. In ten years in plot tests at Auburn it occupied respectively the following positions in yield of lint per acre: 2nd, 5th, 1st, 7th, 8th, 3d, 4th, 1st, 12th and 6th. No variety tested for so long a period has proved more productive, though some newer varieties tested only a few years are slightly ahead for those few years.

*Pinkerton*.—Seed from H. R. Pinkerton, Eatonton, Ga. This variety was lacking in uniformity of seed, but seemed nearest to the Rio Grande group. Maturity, medium. Bolls, small, (79 per pound); seed small; per cent of lint, 36.2.

*Pride of Georgia*.—(Synonym, Malier Prolific). Seed from J. H. Malier, Sunny South, Ga. This Georgia variety is said to have originated about 1895. It is of doubtful classification, the plants lacking uniformity, some having the semi-cluster form. The bolls, which are ovate, and pointed, vary from large to medium. The seed are small to medium, fuzzy and mostly brownish white and greenish white. Maturity, medium. Per cent lint, 34.7.

*Prize*.—(See Lewis.)

*Ptomey*.—(Synonyms, Champion, Peterkin, etc.) This is doubtless a local name in one neighborhood in Alabama for Peterkin; which it resembles in all respects.

*Pullnot*.—Seed from J. E. Bradberry, Athens, Ga. This is a semi-cluster variety. The bolls are of medium size, or above, (71 per

pound of seed cotton), ovate or roundish, and often blunt, with either 4 or 5 locks. It has but slight storm resistance. The seed are of medium size, averaging .12 of a gram, fuzzy, brownish white and brown, with a few deep green seed. This is a very promising prolific variety of medium to late maturity. In three plot tests at Auburn it ranked 8th, 5th, and 4th, or always in the upper quarter of the list in yield of lint per acre. The per cent of lint is high, (36.3).

*Purple Leaf*.—(See Red Leaf and J. C. Cook).

*Rameses*.—An old variety no longer grown. Apparently it was a semi-cluster variety, resembling Peerless. It is described in Bulletins Nos. 33 and 56 of this Station as having long base limbs; upper limbs long but short jointed; plant prolific and early; bolls roundish and of medium size; seed medium, brownish white; staple short.

*Red Leaf*.—(Synonyms, Willett Red Leaf, Willett Purple Leaf). Seed from N. L. Willett Seed Co., Augusta, Ga. This is a unique variety, leaves, stems, squares and bolls being a deep purple. The new blooms are pink instead of white. The plant is large and very ornamental. In shape it is somewhat like a large, long-limbed, long staple variety. The base limbs are numerous, usually 3 to 5, long and growing more nearly upright than in most varieties. It has been claimed that this variety is exempt from cotton rust and some other diseases. At Auburn it has been slightly attacked by rust, but is apparently somewhat more resistant to this disease than most varieties, and retains the leaves better under adverse conditions. In maturity it is late to very late. Storm resistance, slight. The bolls are of medium size (73 per pound of seed cotton), roundish, short pointed, with either 4 or 5 locks. Per cent of lint high (36.8); lint medium or above medium in length. The seed are small, fuzzy, brownish white, due to the black color of seed coat showing faintly through the rather scanty covering of white fuzz. The plant is rather long jointed and not very prolific in proportion to size. In three plot tests at Auburn it ranked in yield of lint per acre, 12th, 9th, and 11th. In color of foliage this plant resembles a cotton grown at the Alabama Experiment Station in the early '90's, under the name of J. C. Cook, (which see).

*Reliable*.—Seed from E. S. Rakestraw, LaGrange, Ga. This is a big boll cotton, resembling Truitt in size of bolls, which are large and pointed, in form of plant, which varies between typical big boll and the semi-cluster form; and in appearance of seed, which are whitish brown and greenish brown. In a single test, the seed were medium to large or a little smaller than seed of Truitt. Maturity late. Per cent lint, 33.

*Rich Man's Pride*.—Seed from E. W. Bond, Athens, Ga. Classification uncertain, plants having few base limbs of medium length, few short upper limbs; bolls above medium size, ovate, pointed; medium maturity, fuzzy seed, mostly brownish and greenish. Per cent of lint, high.

**Roby.**—Seed from J. E. Roby, Goodman, Miss. This variety seems to be intermediate between the big boll and the long limbed group. In a single test at Auburn it was considered promising on account of prolificacy, high per cent of lint, and rather large bolls, (66 per pound of seed cotton). The plants are large, abundantly supplied with limbs and bolls; both lower and upper limbs are long. Seed fuzzy, medium size, very variable in color, from brownish white to deep brown, with an occasional deep green seed.

**Rogers.**—Originated about 1890 by R. H. Rogers, Darlington, S. C., as the result of crosses between (1) Jones Improved, (2) a small balled, storm-resistant, "cluster" form of Herlong, and (3) Jowers, the latter a small round boll, very prolific cotton. This variety belongs both in the big boll and the semi-cluster groups, and resembles Dongola and Montclare. The bolls are large (62 per pound of seed cotton), decidedly storm resistant, and have 5 and 4 locks, not opening wide. The bolls are roundish, pointed or blunt. The seed are large, brownish white, and greenish. Per cent of lint above medium; maturity, medium to late.

**Rosser No. 1.**—This variety of uncertain classification is apparently intermediate between the King and the big boll group. It has medium sized, ovate, pointed, bolls; seed mostly brownish, fuzzy, and small. In prolificacy, maturity, and storm resistance, it is medium. Per cent of lint is above medium.

**Rowden.**—This variety, which originated in Texas, belongs in the big boll group (60 bolls making one pound of seed cotton). The bolls are ovate, pointed, relatively storm resistant, the locks, mostly 5, hanging together in a compact mass, making picking easy. Per cent of lint above medium; maturity medium; lint, medium length. This variety has many valuable qualities, but has the weakness of having a small number of bolls, and an insufficient number of limbs. In a single field test at Auburn it stood 5th in yield of lint among 40 varieties tested. It is one of the favorite varieties in the boll weevil region of Texas.

**Ruralist.**—This variety was originated a few years ago by J. F. Merriam, Battle Creek, Ga. This is a big boll variety averaging in two years' tests 64 bolls per pound of seed cotton. The bolls are ovate, pointed, opening well; the per cent of lint is low; the seed are of medium size, mostly brownish white, brown and green. Maturity, medium.

**Russell.**—(Synonym, probably Bancroft.) This variety was originated about 1897 by J. L. Russell, Alexander City, Alabama, from a single chance plant of unusually thrifty growth and having very large bolls, found in his field. It has become a wide favorite, and probably divides the honors with Peterkin and Truitt of being the variety most extensively grown in Alabama at present. The plants are of medium size, having two to four base limbs of medium length, upper limbs of short to medium length. The leaves are characterized by large size and shallow indentations between the lobes. The bolls are large (averaging 62 per pound of seed cotton), long, ovate, tapering gradually to a point, opening well, and easily picked. The

per cent of lint is below medium (32.9). The seed are large, densely covered with fuzz, either green or greenish brown. In maturity, Russell is late. In field tests at Auburn its rank in yield of lint per acre was 1st, 8th, 20th, 6th, and 15th, averaging about midway of the list for the years when it was tested. It stood ahead of Truitt three years and was beaten by Truitt two years. In all points, including characters of plants, foliage, seed, and yield, Russell and Bancroft Herlong have been practically identical. While no historical or documentary evidence has been found bearing on the point, my opinion is that Russell and Bancroft are identical, the Russell probably being a selection from a chance plant of Bancroft, found in Mr. Russell's field. This view is supported by the similarity in all points and by the further fact that, excepting a few strains exploited within the past few years, no other varieties have been found having the unique seed characters common to Bancroft Herlong and Russell.

*Rust Proof.*—Noted in Alabama Experiment Station Bulletin No. 56 as having large bolls, low per cent of lint. No longer obtainable under this name.

*Sam Woodfin Prolific.*—A selection from Woodfin and identical with the parent variety.

*Seabrook.*—This is a variety of Sea Island cotton (see above) originated by F. P. Seabrook, James Island, S. C. Among Sea Island cottons it is classed as a medium grade of staple and hard to gin on the gins commonly employed for that class of cotton, on account of some green fuzz on the seed. It is regarded as productive for this class of cotton, and better suited than most Sea Island strains for cultivation in the interior. The seed, averaging .11 gram and 26 per boll, are mostly naked and black, except for a tuft of greenish brown fuzz at each end of the seed. The per cent of lint was 28.1; bolls per pound of seed cotton 112. It did not mature its entire crop at Auburn.

*Sea Island.*—This belongs in a different species from the short staple and long staple upland varieties, being classed by botanists as *Gossypium barbadense*. The plants are very large and have long slender limbs; stems and leaves are free from hairiness. The bolls are very small and slender, tapering gradually to a sharp point; surface of bolls pitted. The leaves are entirely unlike those of short staple and long staple upland varieties, the lobes (usually 5) being separated by deep indentations. At Auburn the Sea Island matures only a small portion of its forms. The young bloom is cream colored instead of white, and has a red spot inside the flower, near the base of each petal. The per cent of lint is very low, averaging at Auburn 26.5; it required 127 bolls to make one pound of seed cotton. The seed, which are naked and black, were of large size (.13 gram), and the average was only 21 seed per boll. Lint very long, fine and silky.

*Scogin.*—(Synonym, Culpepper, which see). A selection made by

J. F. Scogin, Luthersville, Ga., from Culpepper, from which it cannot be distinguished.

*Sewell*.—A local name for a big boll, unprolific, large-seed variety with low per cent of lint. Seed mostly brownish white.

*Shine*.—(Synonyms, Shine Early, Shine No. 1, etc.) Originated by J. A. Shine, Faison, N. C., about 1875, who states that it is descended from Sea Island and from a little known variety called Micasucie. This is an early variety, but not quite so early nor so uniform as King. Some of the plants are of the short limbed type and some of them resemble King. This variety is inferior to King in per cent of lint (averaging only 32 per cent), and in two tests at Auburn, in which it was compared with King, the yield of lint was lower. Storm resistance, poor; bolls small (90 per pound); seed small, fuzzy, brownish white and greenish.

*Shine No. 2*.—This cotton, of variable type and uncertain classification, was originated by J. A. Shine about 1900, who states that its parent was Texas Bur.

*Shine Black Seed*.—(Synonyms, Hood and probably Peterkin.) This cotton is evidently a selection from Peterkin, which it resembles in all points.

*Schley*.—This is a selection from Jones Improved made by the Georgia Experiment Station. In one of our tests it exceeded and in another test fell below its parent in yield of lint per acre. It belongs to the big boll class, and is perhaps a little more erect and compact than its parent. The selection has increased the per cent of lint (34.1) and slightly decreased the size of seed, has made maturity earlier, and the form of plant more compact.

*Simms*.—(Synonym, Simms Long Staple). Seed obtained from J. F. Weekley, Wheeler, S. C. This long staple variety had bolls of medium size, medium sized seed, mostly fuzzy and brownish. The plants were not productive. Maturity, medium to late.

*Sistrunk*.—This is a selection made by W. E. Sistrunk, Tallassee, Ala., beginning at a time when he was growing both Crossland and Hawkins varieties. As grown in 1905 it had not become entirely uniform, but the majority of plants had the Rio Grande characteristics, being evidently mostly selections from Crossland. The bolls are of medium size (72 per pound); per cent of lint high (36.7); seed small (.098 gram), mostly with a scant covering of a brownish fuzz. Plants prolific, and of medium to late maturity.

*Smith Improved*.—Seed from A. J. Smith, Conyers, Ga. This is a big boll variety with large fuzzy seed, which are brownish white and greenish white.

*Smith Standard*.—(Synonyms, Ben Smith, and Smith Choice, Bush). A big boll variety with large fuzzy seed and medium per cent of lint, medium maturity.

*Southern Hope*.—Seed from Marx Schaefer, Yazoo City, Miss. In shape of plant this is a typical long staple. The bolls are medium size, ovate, pointed. The staple is short for the long staple group. Per cent of lint is 30.6. Bolls medium size, 78 making a pound of



seed cotton; seed small to medium, fuzzy, white and brownish white; maturity medium.

*Southern Wonder*.—Seed from L. F. Grier, Oxford, Alabama. This is a big boll variety (52 bolls per pound), with medium per cent of lint, large, fuzzy, brownish white, brown, and green seed. It is moderately prolific and of medium to late maturity.

*Spearman*.—(Synonym, Spearman Choice). Seed from W. R. Spearman, Social Circle, Ga. This is a big boll variety of medium maturity; plants compact and moderately prolific, approaching the semi-cluster form. The bolls are large (56 per pound), roundish, often blunt pointed. The seed are smaller than those of most big boll varieties, averaging .106 gram. The seed are fuzzy, mostly brownish white. The per cent of lint is low (31.7).

*Speight*.—Seed from J. B. Speight, Winterville, N. C. Classification uncertain, but probably it represents a form of the Rio Grande group; plants prolific, well shaped and suggesting Peterkin; bolls small, ovate; seed small, variable, either fuzzy, brownish white, greenish, or brown, or nearly naked. Per cent of lint 33.7, or very low for the Rio Grande group.

*Spruiell*.—(Synonyms, Spruiell Re-Improved, Spruiell Green Seed, Spruiell Prolific). Originated by A. M. Spruiell, Leeds, Alabama, as a selection from Hutchinson. We have grown this cotton from the originator for several years under each of the above names, and have found the strains to be practically the same, the differences between the different strains being less than the differences between the individual plants of the same strain. This seems to be an intermediate between the big boll group and the King group. The bolls are above medium size (61 to 72 per pound, averaging 67 for the three strains), ovate, pointed. In maturity it is early to medium, or earlier than most varieties with bolls of this size. Further improvement in the matter of uniformity is needed. Seed, medium to large, fuzzy, whitish brown, greenish brown, brown and green.

*Sterling*.—Seed from L. W. Dance, Eatonton, Ga. This is a prolific semi-cluster cotton of early to medium maturity. It resembles Woodfin and the more compact, erect plants of Hawkins. Bolls small (93 per pound), ovate, sometimes obtuse, seed small, mostly brownish white. Lint short to medium in length; per cent of lint, medium.

*Storm Proof*.—(See Texas Storm Proof.)

*Strickland*.—Originated by J. R. Strickland, Gordo, Ala. This is a big boll variety, with plants typical of that group. The bolls are large, (58 per pound), ovate, usually blunt-pointed. The per cent of lint is low, (32.5). The seed are large, fuzzy, mostly brownish white. Lint above medium. In two plot tests at Auburn, Strickland ranked 7th and 11th in yield of lint per acre. This variety very closely resembles Truitt.

*Sunflower*.—Seed from Marx Schaefer, Yazoo City, Miss. This is a long staple variety with plants, bolls and fibres typical of that group. The bolls are small, (83 per pound of seed cotton), slender,

tapering to a sharp point and having either 4 or 5 locks. The plant is prolific for a long staple variety. Storm resistance medium. Seed small to medium, white and brownish white. Maturity medium to late. Fiber long; per cent. of lint, low, (29.2).

Like the other long staple varieties it has stood near the bottom of the list in yield per acre of lint at Auburn, about equalling Florodora.

*Tatum*.—(Synonym, Tatum Big Boll.) Seed from R. D. Tatum, Palmetto, Ga. The plants are well shaped and characteristic of the big boll group. Bolls large, (58 per pound), abruptly pointed. Per cent. of lint, 33.2; seed, large, fuzzy, brownish white and greenish white. Maturity, late. This variety resembles Strickland, but has a larger per cent of greenish seed, which average smaller.

*Texas Bur*.—Originated by C. E. Smith, Locust Grove, Ga., by selections since 1895 from an unknown variety originally from Texas. This is a big boll variety, with rather few medium length limbs, and medium maturity. Per cent. of lint, low. Seed of medium size, fuzzy, mostly brownish white, but with some greenish seed. In two plot tests at Auburn it ranked in yield of lint per acre about one-third the distance from the top of the list. On account of its apparent earliness for a big boll variety this cotton is worthy of preservation and improvement through an increase in the number of limbs and bolls.

*Texas Oak*.—(See Peterkin.) A variety of the Rio Grande class and identical with Peterkin, but having a lower per cent of lint, (34.2.)

*Texas Storm Proof*.—(Synonyms, Bahama, Drought Proof, Storm Proof). A big boll variety with medium per cent of lint; very large, fuzzy seed, (.16 gram), mostly brownish white. Some of the seed obtained under this name contained nearly or quite naked, black seed like Peterkin. Bolls very large, pointed; storm resistance considerable; maturity, late.

*Texas Wood*.—This is similar in all respects to Peterkin, which see.

*Thrash*.—See Wyche.

*Todd*.—(Synonym, Todd Improved). Seed from P. W. Todd, Grantville, Ga., who states that it originated about 1892 by selection from a field where "storm proof" and two other varieties were planted. This is a typical big boll variety with very large bolls, (51 per pound), bolls ovate, pointed, and usually with five locks. The per cent of lint is medium (33). Seed very large, (.169 gram), fuzzy, mostly whitish brown, but with some greenish seed. Maturity late; fairly prolific.

*Todd Early*.—Distinct from above; small bolls; classification uncertain.

*Toole*.—Originated by W. W. Toole, Augusta, Ga., in 1894 as a selection from Peterkin. It is probably an intermediate form between the Rio Grande group and the King group, being much closer to the former. In a few plants were found red spots on pet-

als, pointing to kinship to King. This is a very prolific variety. The plants are of medium size, symmetrical and abundantly supplied with bolls and limbs. The bolls are small (88 averaging in our tests one pound of seed cotton). The bolls are ovate, abruptly pointed, with five or four locks, opening wide and allowing seed cotton to fall out rather easily. The seed are small (only .086 gram), a part of them quite fuzzy and pale brown, but most of them appearing dark brown by reason of the very scant covering of white or brownish fuzz, through which the dark seed coat can be seen indistinctly. The per cent of lint is very high, (averaging 38.5). In maturity Toole is early or early to medium, being later than King and a little earlier than Cook. It has proved more productive than King or Peterkin, standing 1st and 3rd in two field tests at Auburn, or about equal to Cook. Its principal defect is the small size of bolls. Its earliness and productiveness should make it a favorite, especially after the appearance of the boll weevil.

*Triumph*.—(Synonyms, Mebane, Mebane Triumph). This variety was originated by Mr. ——— Mebane in the southern part of Texas, but our seed were obtained from J. L. & W. B. Myrick, Lott, N. C. This is a big boll variety, with immense bolls, only 46 bolls being required to make a pound of seed cotton. Other conspicuous merits of this variety are the facts that it is earlier than most big boll cottons, ranking as medium in maturity, and that it has a very high per cent of lint, (38.6 in our test). The seed are numerous, of medium size, (averaging .127 of a gram), fuzzy, brownish white and greenish. This cotton is somewhat resistant to storms; lint, of medium length or above. The yield of lint was not determined at Auburn, only a small area of this variety being grown. While not especially well balled here, this variety has enough merit to make it a favorite in case its yield of lint in our 1907 test shall equal that of other leading varieties. This variety has been especially satisfactory in regions infested with the boll weevil.

*Truitt*.—(Synonyms, Truitt Big Boll, Truitt Premium). This is a popular and widely grown big boll variety, originated by George W. Truitt, LaGrange, Ga., by selection from the so-called "Old Georgia White Seed." The bolls are large (averaging in four years' tests, 58 per pound of seed cotton). The plants are well shaped and more prolific and more nearly approaching the semi-cluster type than do many of the big boll varieties. Bolls are large, ovate, pointed, opening wide, and not storm resistant. Seed large, fuzzy, mostly brownish white to white. Maturity, late, but not quite so late as Russell. This variety has been tested in plot experiments at Auburn for eleven years and ranked in yield of lint in the respective years 1st, 3rd, 2nd, 4th, 2nd, 9th, 5th, 2nd, 24th, 16th, and 14th.

*Tucker*.—(Synonym, Boyd.) Seed from W. B. Tucker, Opelika, Ala., who selected it from Boyd Prolific. Plants variable, mostly short-limbed; per cent of lint 34.9; bolls small; seed small, fuzzy, brownish white, brown and greenish; maturity, early to medium.

*Tyler*.—(Synonym, Tyler Limb Cluster). This is a semi-cluster

variety from South Carolina, which is now probably extinct. Bolls small; seed like Peterkin; but per cent of lint only medium.

*U. S. Department of Agriculture Nos. 145, 149.*—These are selections made on account of wilt resistance by W. A. Orton. They have all been discarded because inferior in this point to Dixie and to U. S. D. A No. 128, below.

*U. S. Department of Agriculture, No. 128.*—(Synonym, Jackson Wilt Resistant). A selection from Jackson Limbless made by W. A. Orton since 1890, with a view to increase its resistance to cotton wilt.

*Victor.*—(Synonyms, Combination, Peterkin, etc., which see). A strain of Peterkin from South Carolina that is abundantly supplied with bolls, the small size of which (89 per pound), makes it inferior to the parent. The seed are very small, brown, mostly fuzzy.

*Warren.*—Seed received from J. B. Warren, Moscow, Miss. Classification uncertain; not especially promising.

*Webb.*—This cotton from North Carolina includes two types, one is semi-cluster and one resembles the larger plants of King. Early, but otherwise unpromising.

*Webber-Russell.*—A hybrid made by Dr. H. J. Webber, between Russell and some long staple variety. As tested in 1906 it had most of the characteristics of Russell, but smaller leaves, large, slenderer, and more pointed bolls, many white seed as well as the usual large green seed; fibers of unequal length on the same seed. It would not yet take rank among the long staple varieties. In a single test the yield of lint was slightly above that of Russell.

*Welborn.*—(Synonym, Welborn Pet.) A cluster variety now difficult to obtain, originated by the late Jeff Welborn, of Texas. Plants of medium height, consisting of a central stem with very short fruit limbs and one to four base limbs of medium length. Plant resembles Jackson, but the bolls are slightly smaller, (91 per pound) and less tapering; bolls ovate, thickly clustered, abruptly pointed. Maturity, early, but later than King. A peculiarity of this variety was the opening of most of its bolls about the same time. Per cent of lint above medium.

*Whitley.*—A local name in Lee County, Alabama, for a strain that is no longer maintained.

*Whitten.*—(Synonym, Whitten "Cluster.") A local name in the eastern part of Alabama for a big boll variety that seems to be a selection from Cummings or Peerless. Bolls, large, pointed; seed large, fuzzy; per cent lint, high; the plant resembles the so-called Drake "cluster" from Alabama.

*Wilson.*—(Synonym, Wilson Matchless). Seed from F. D. Wilson, Littleton, N. C. Classification uncertain. Bolls medium size, ovate, pointed, usually 5 locks; wood or base limbs one to five, of medium length. Per cent of lint low, (32.2). Seed small, fuzzy, brownish white and greenish white. Maturity, medium.

*Wisc.*—(Synonym, Peterkin, etc., which see.)

Seed from H. P. Jones, Herndon, Ga. The plant in all qualities

is not distinguishable from Peterkin, though in five years' tests it averaged 1 1-2 per cent higher in per cent of lint (39.5) and the seed averaged slightly smaller (.087 gram). It is possibly a few days later than Peterkin.

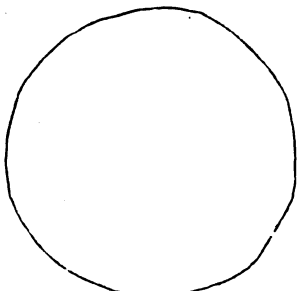
*Wonderful*.—An old long staple variety no longer obtainable. Described in earlier bulletins of this Station as having a large plant, with long, drooping, long-jointed limbs; bolls large, and pointed; maturity late; staple long; seed large, fuzzy, brownish white.

*Woodfin*.—(Synonym, Nonpareil.) Originated by S. V. Woodfin, Marion, Alabama, about 1898, who states that the parent varieties were Peerless, Peterkin, and one that he calls Senegambia. This is a well shaped plant of the semi-cluster type. The bolls are small, ovate, pointed, with either five or four locks. Maturity medium, to late; per cent of lint low to medium; seed small, fuzzy, mostly brownish white and greenish. This cotton is identical with Sam Woodfin Prolific and closely resembles Sterling and the most compact plants of Hawkins.

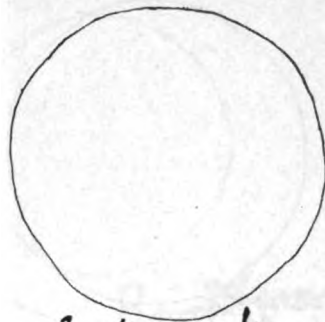
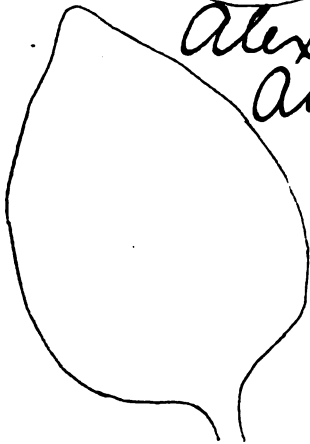
*World's Wonder*.—(Synonyms, Probably Defiance and Drake's Defiance; see Defiance.)

*Wyche*.—(Synonyms, Wyche Big Boll, Thrash). Seed received from J. S. Wyche, Wooster, Ga. who states that this variety originated there about 1873. This is a typical big boll variety, 59 bolls making a pound of seed cotton. Per cent of lint medium; bolls ovate, pointed, and with either five or four locks. The seed are large, mostly white or brownish white. Wyche resembles Jones Improved.

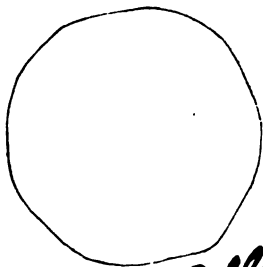
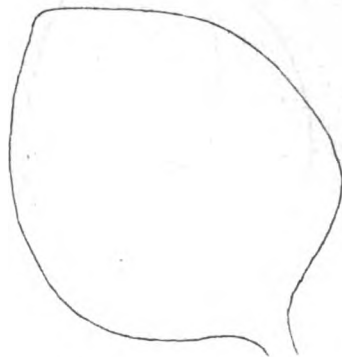
*Zellner*.—Extinct. Described in Alabama Experiment Station Bulletins Nos. 33 and 56 as having a plant of medium size; bolls roundish, of medium size; early; per cent of lint very low; staple short. This was apparently a semi-cluster variety.



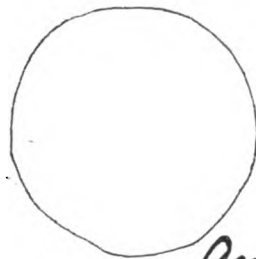
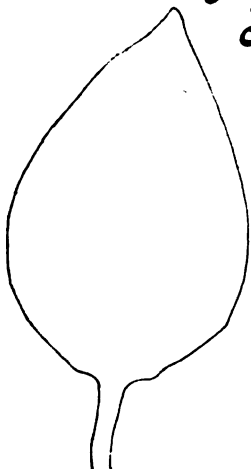
Alex.  
Allen



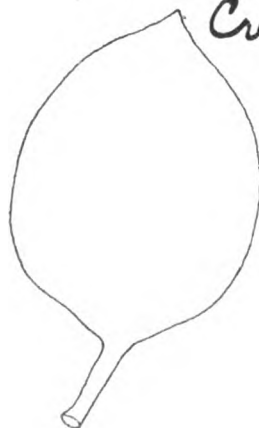
Anderson's  
Prolific



Allen's  
L.S.

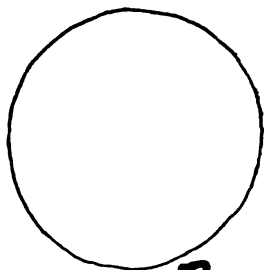


Anson's  
Cream

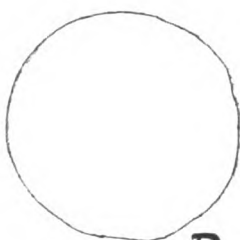
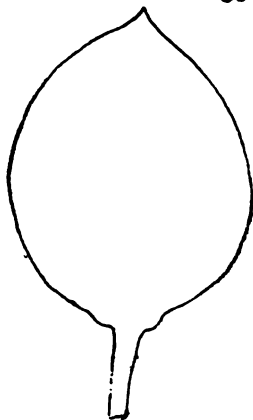
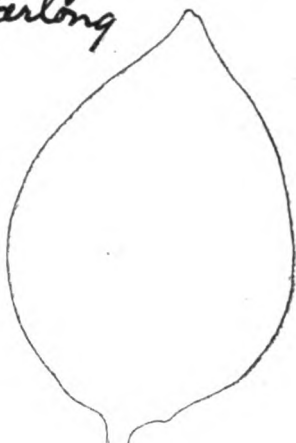




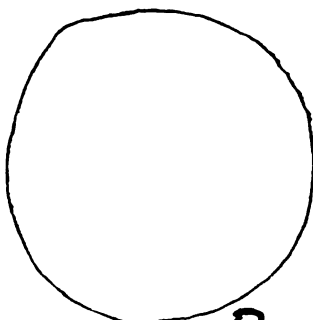
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Hurlong*



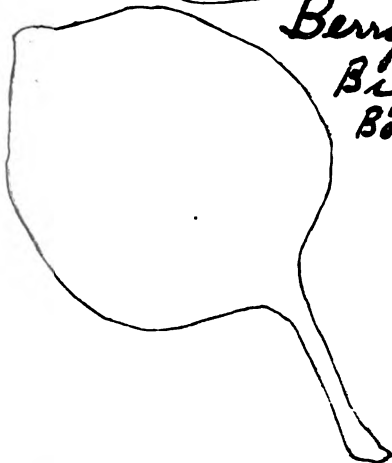
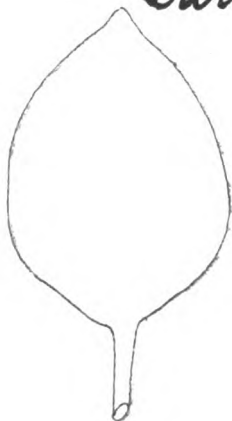
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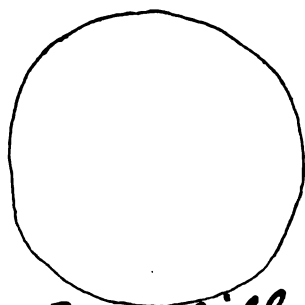


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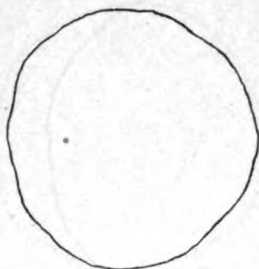
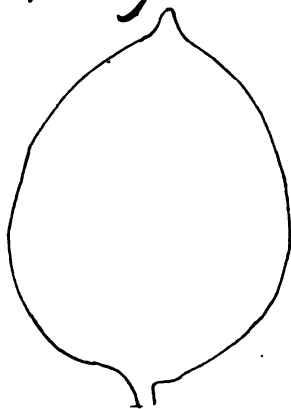


*Berry's  
Big  
Boa*

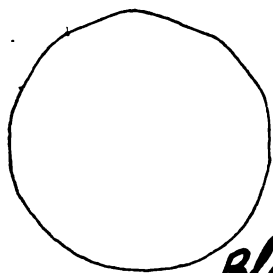




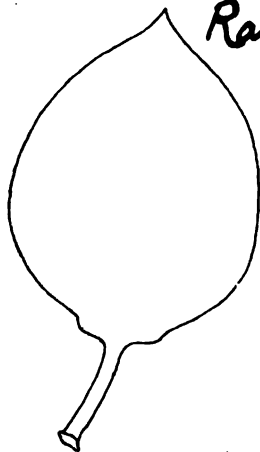
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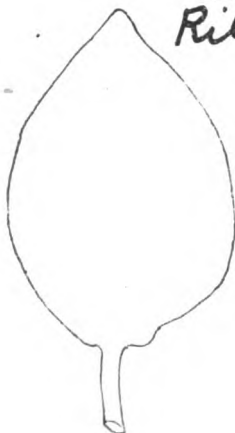
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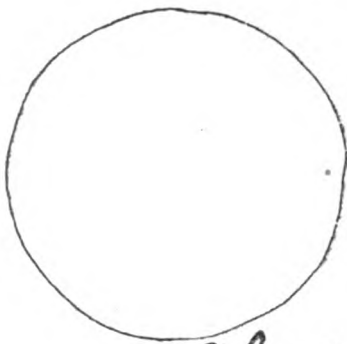
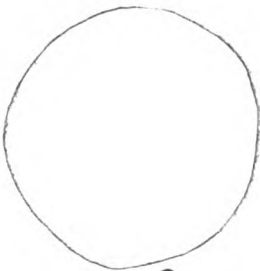
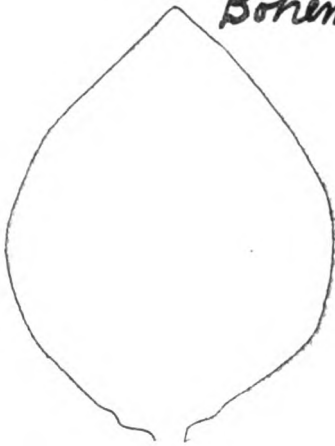
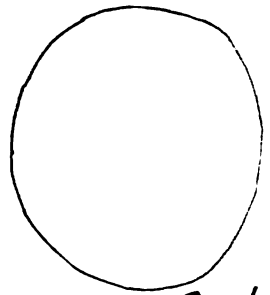
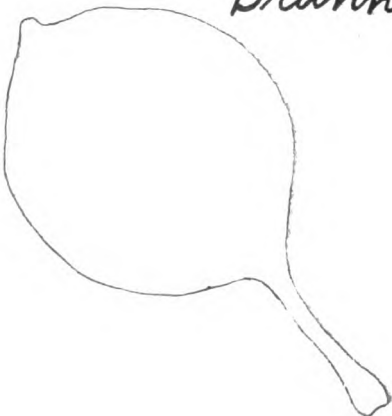
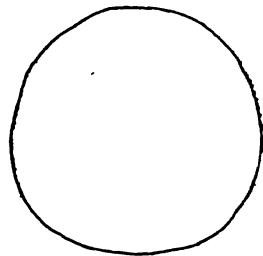
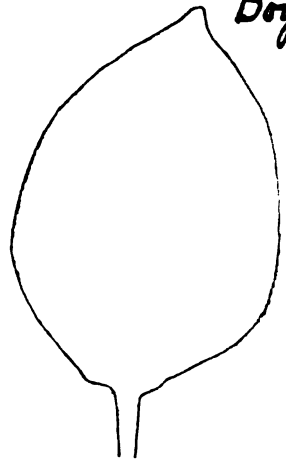
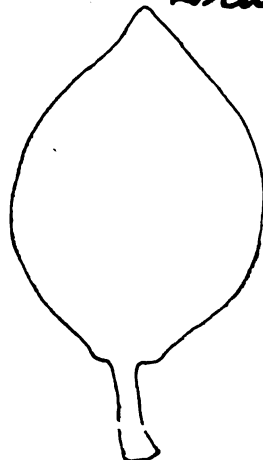
*Black  
Rattler*



*Blue  
Ribbon*





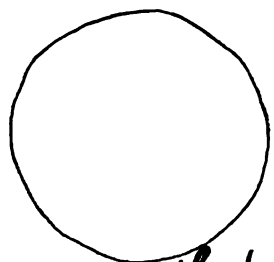
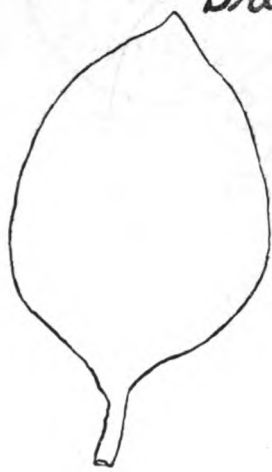
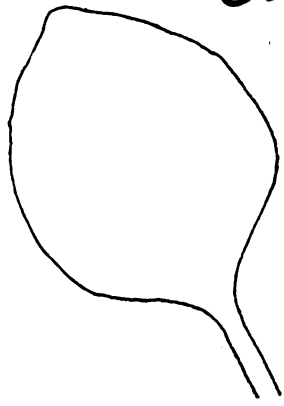
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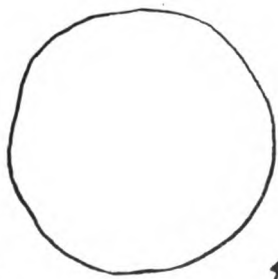
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Cluster*



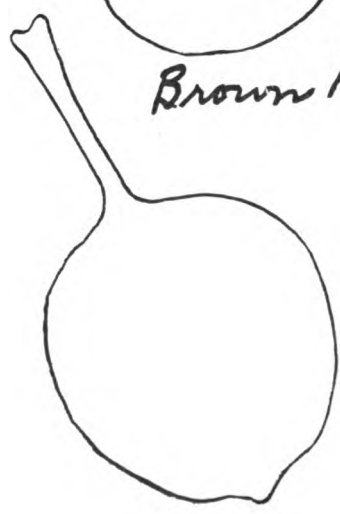
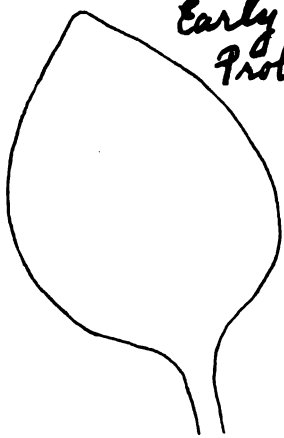
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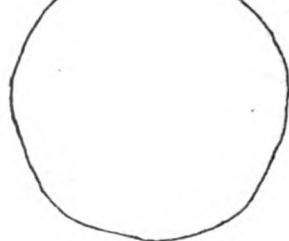


*Butler's  
Early  
Prolific*

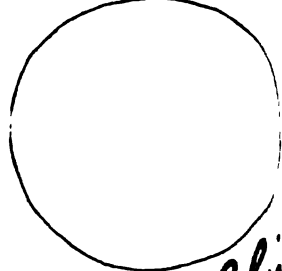
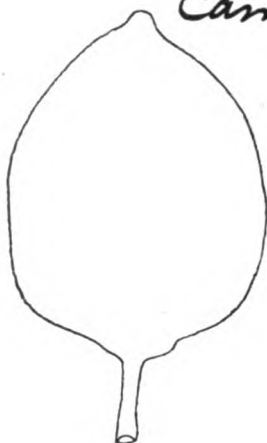


*Brown No. 1.*

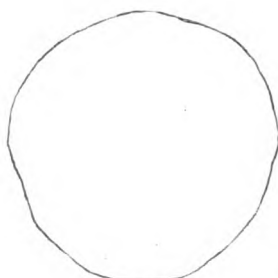
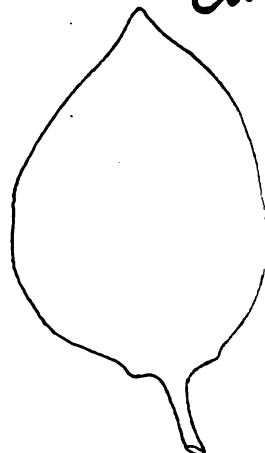




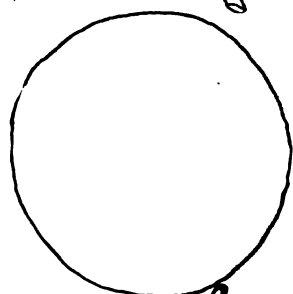
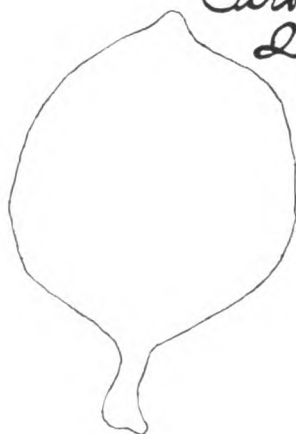
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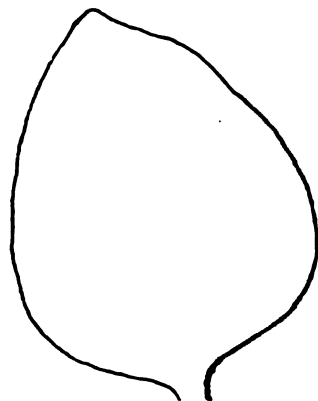
*Clitt*

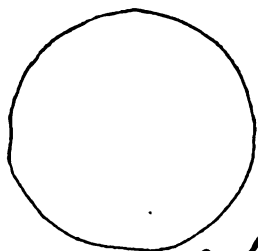


*Carolina  
Queen*

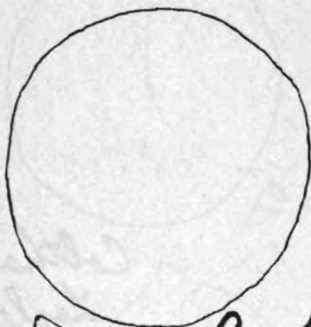
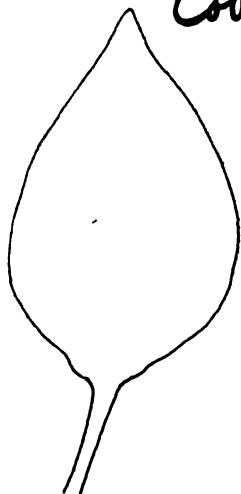


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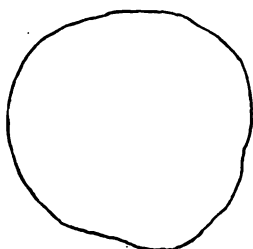
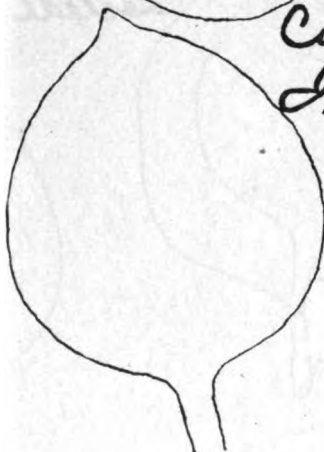




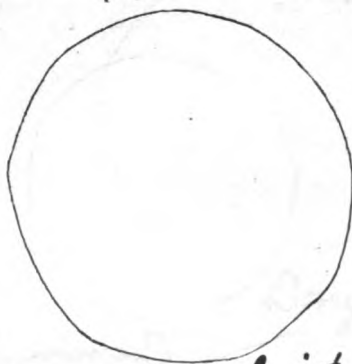
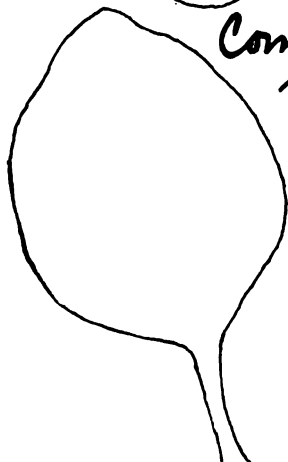
*Cobweb*



*Cook's  
Impd.*

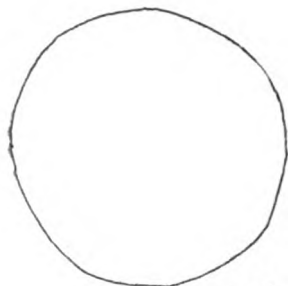


*Combina-  
tion*

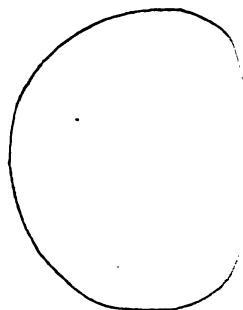
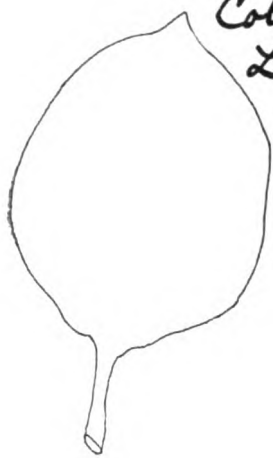


*Christo-  
pher*

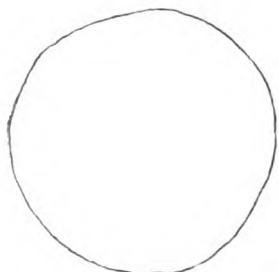
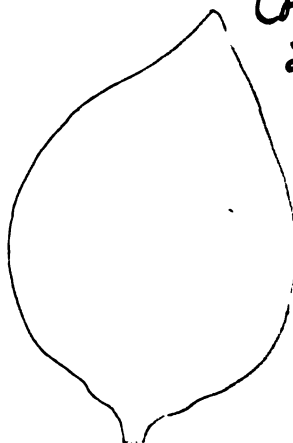




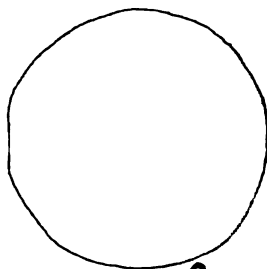
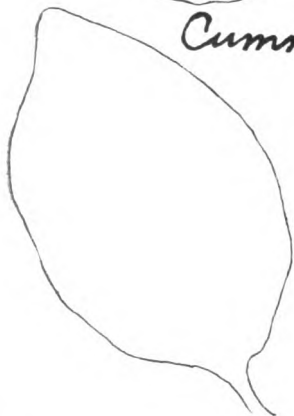
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Laclede



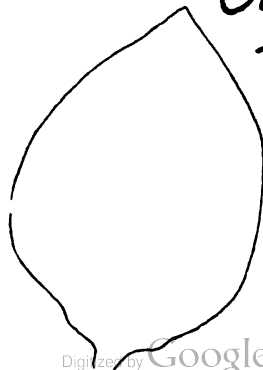
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L1

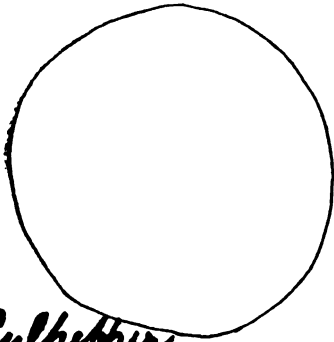
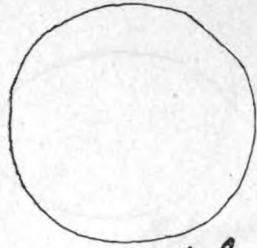
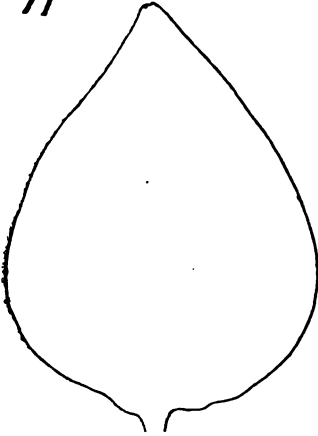
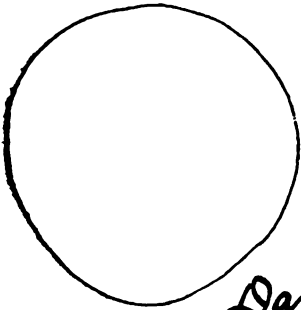
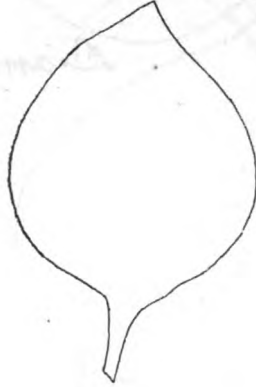
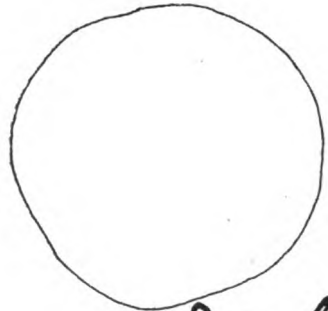
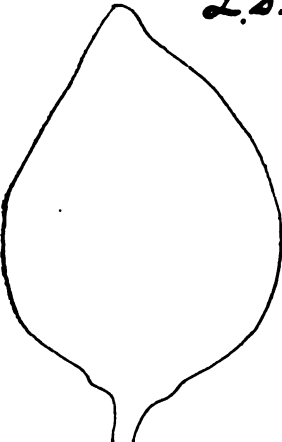
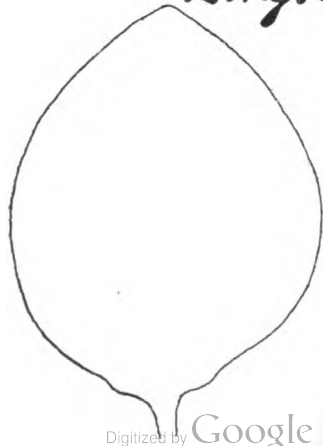


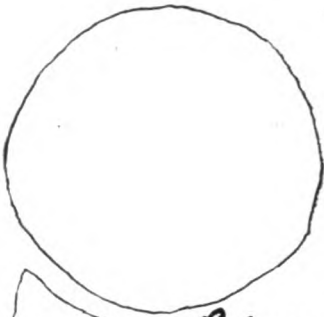
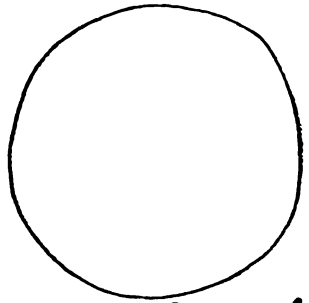
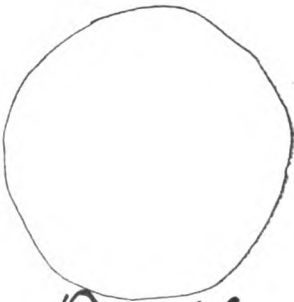
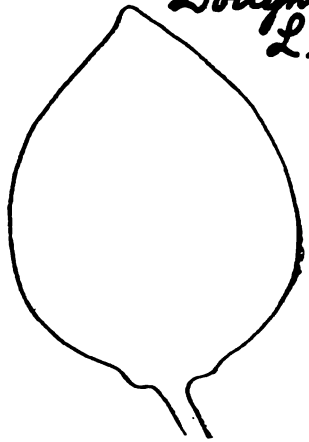
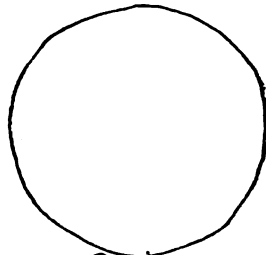
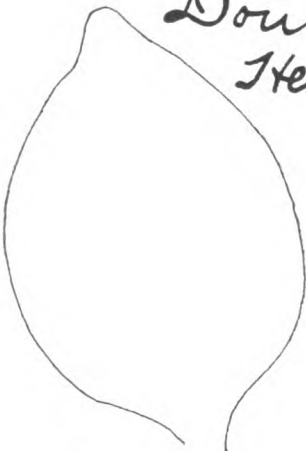
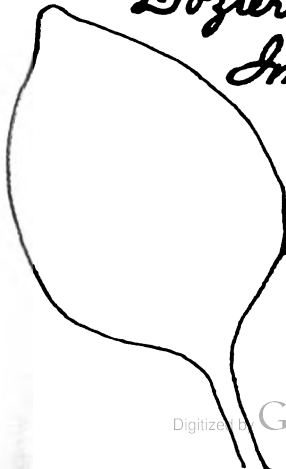
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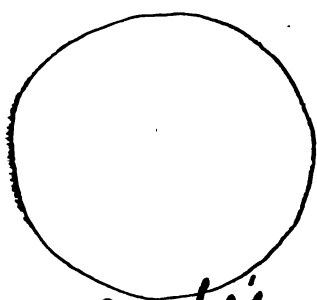


Crow-  
land

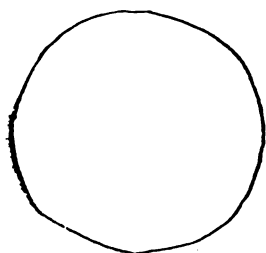
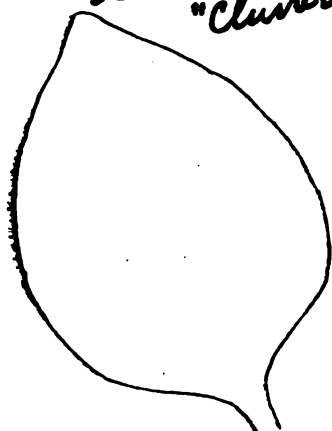


*Culpepper**Dickson**Davis  
L.S.**Dongola*

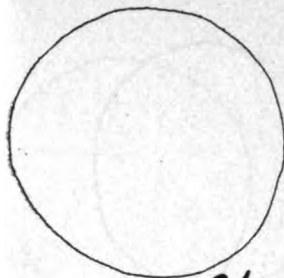
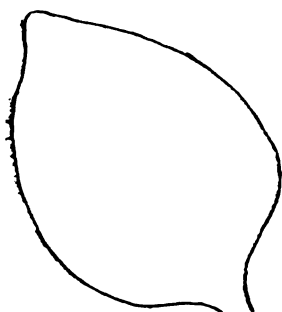
*Diamond**Doughty  
L.S.**Double  
Header**Dozer's  
Impd.*



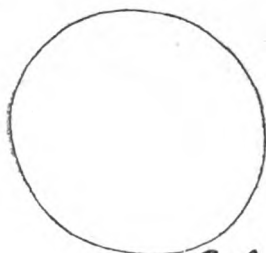
Drake's  
"cluster".



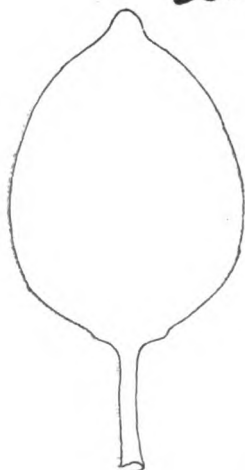
Drake's  
Defiance



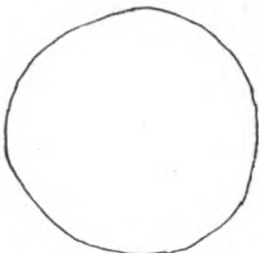
Edgeworth



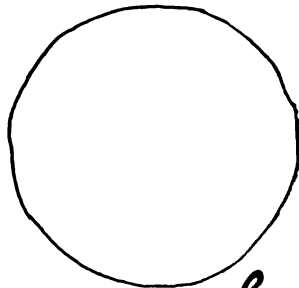
Ellis



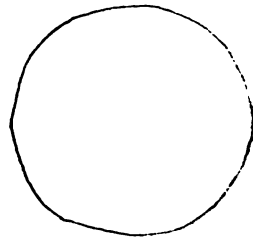
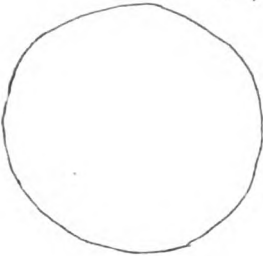
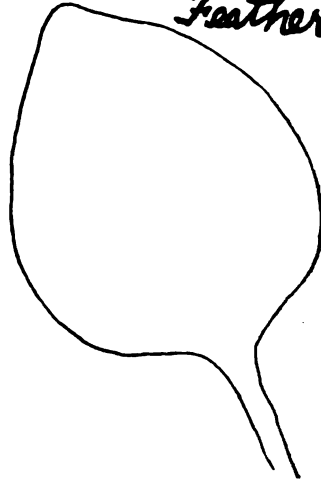
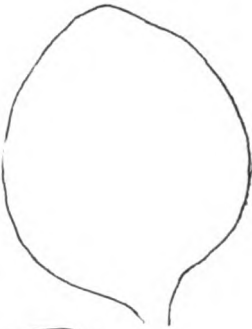




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Early*

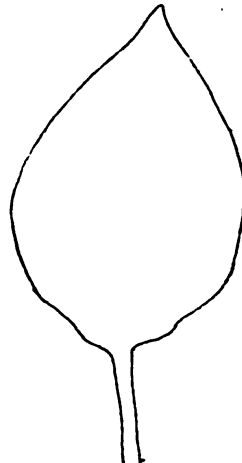
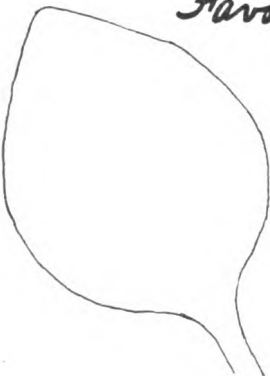


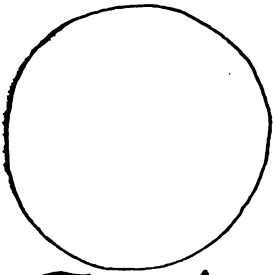
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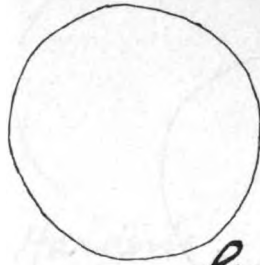
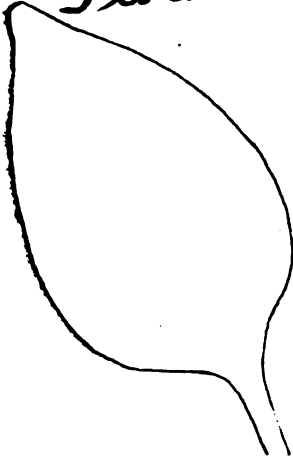
*Ferguson*

*Favorite*

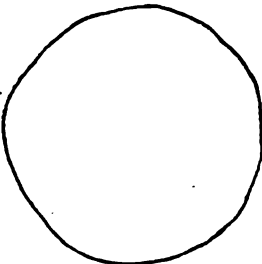
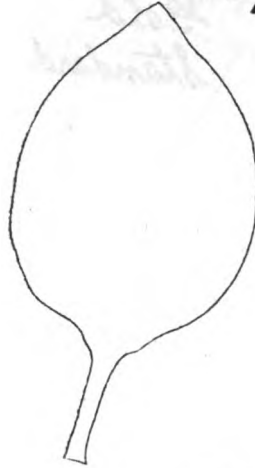




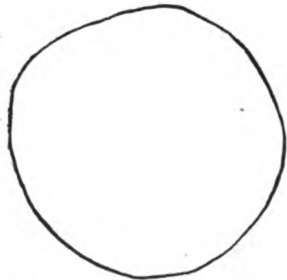
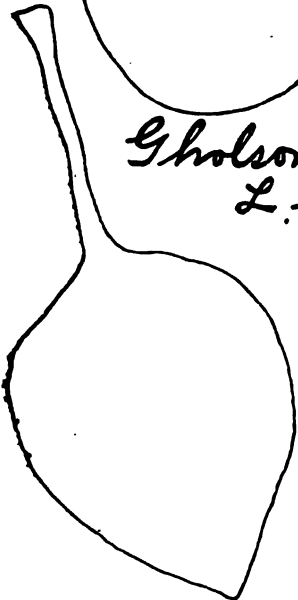
*Floradora*



*Gayosa*

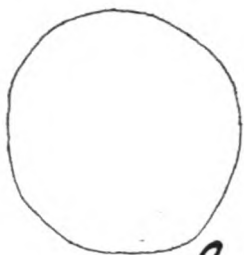


*Gholson*  
L.S.

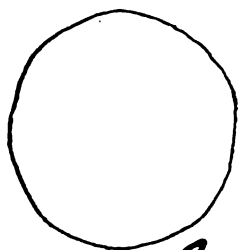
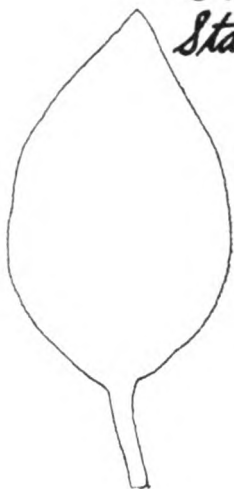


*Garrard*

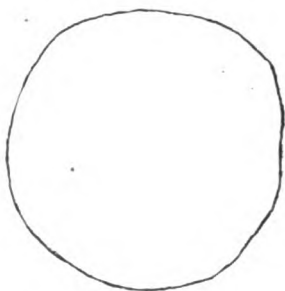
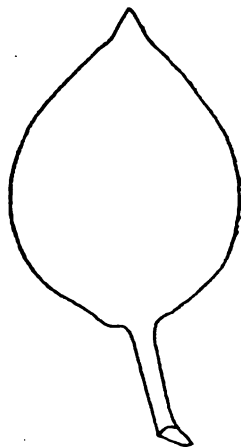




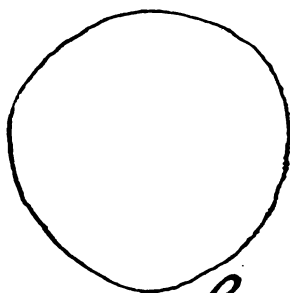
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Standard*



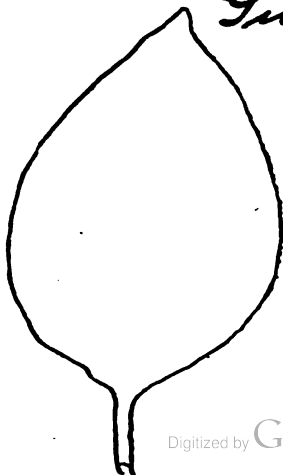
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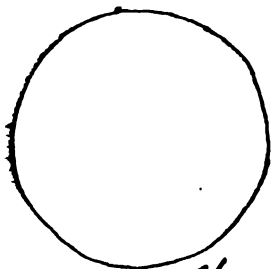


*Gregg*

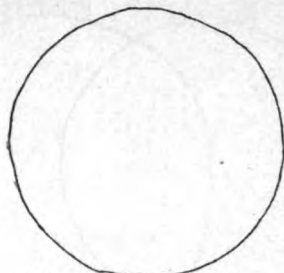


*Gunn*

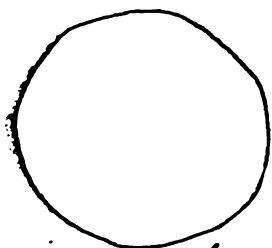
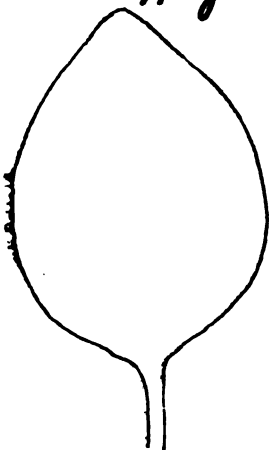




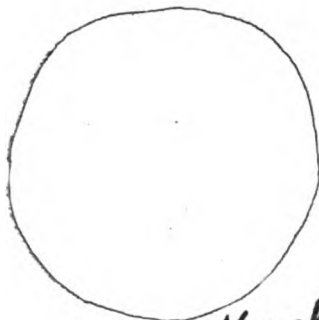
*Hagaman*



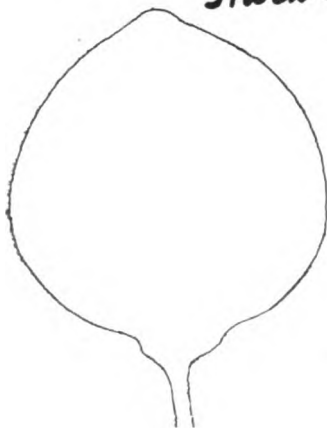
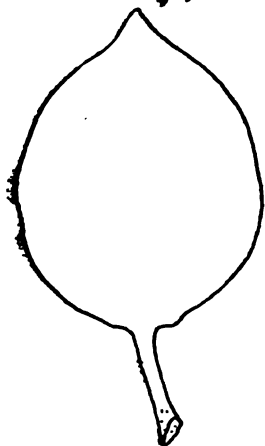
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Imp'd*

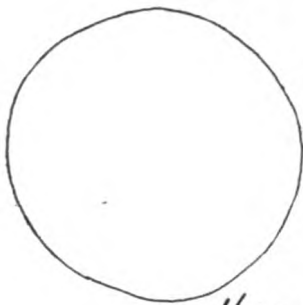


*Hawkins*

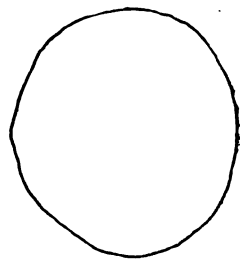


*Haralson*

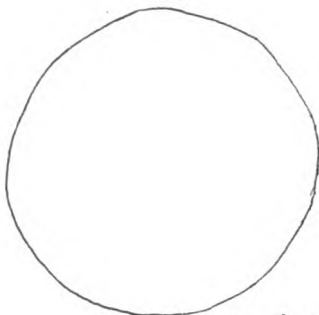
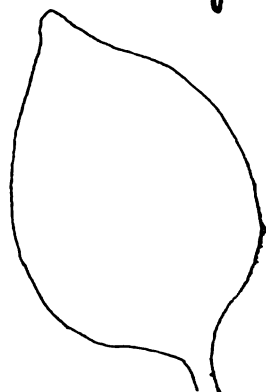
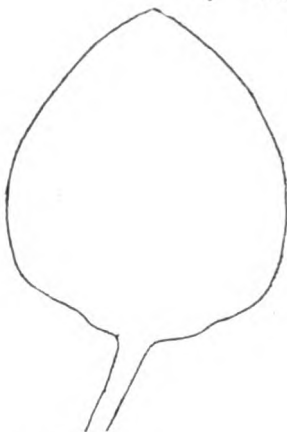




*Herndon*

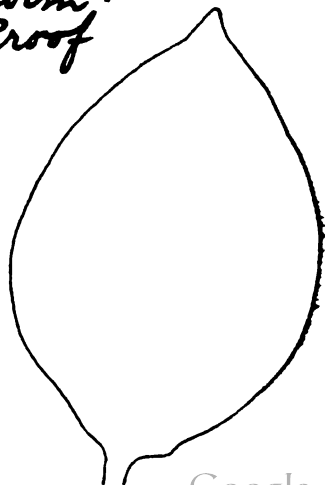
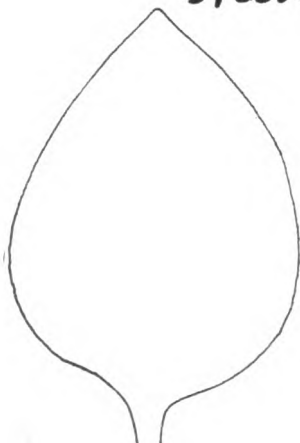
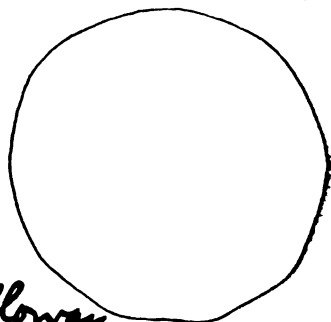


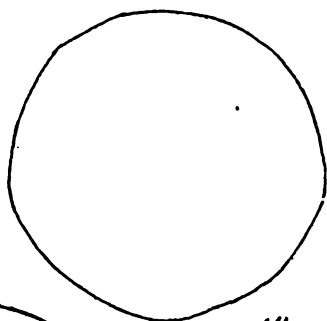
*Hodge*



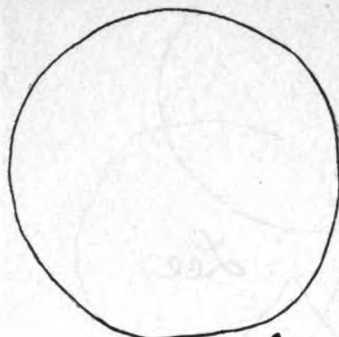
*Hilliard*

*Holloway  
Storm  
Proof*

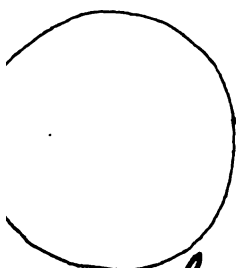
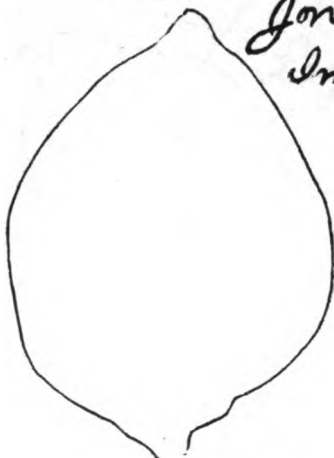
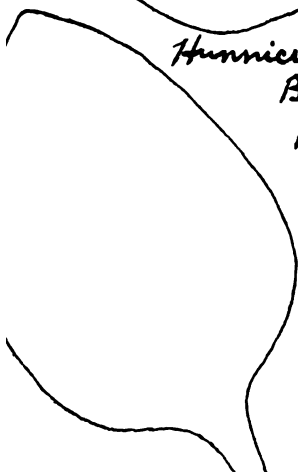




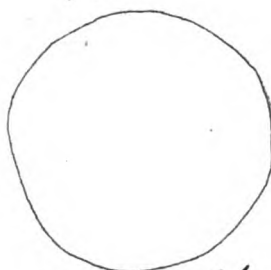
Hunnicutts  
Big  
Boll



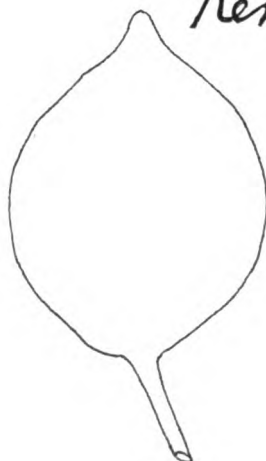
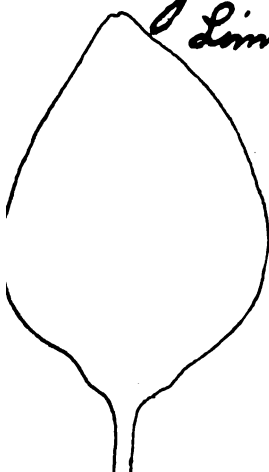
Jones  
Imp'd



Jackson  
Limbless

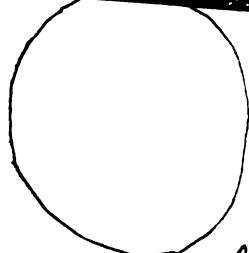
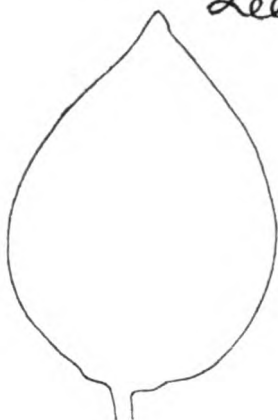


Keno

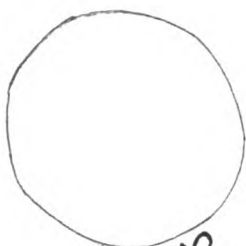
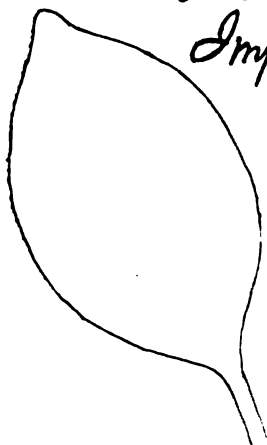




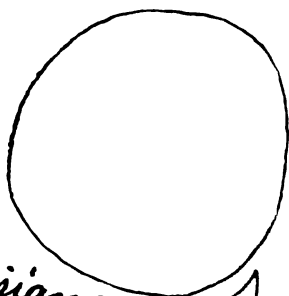
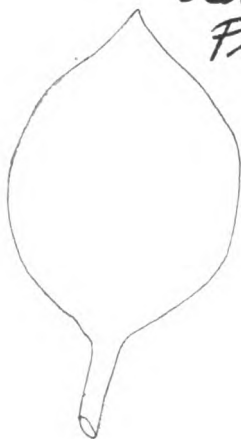
*Lee*



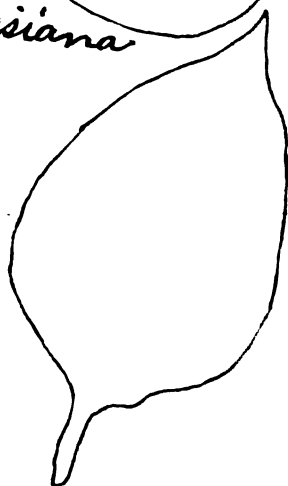
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Imp'd*

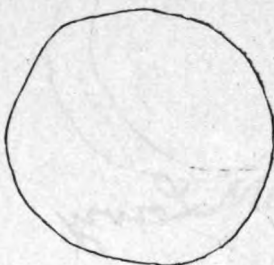
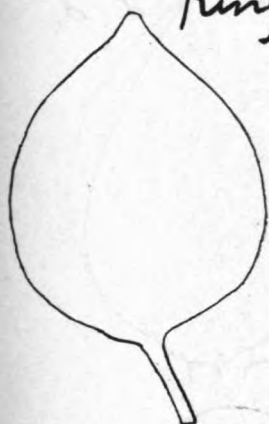
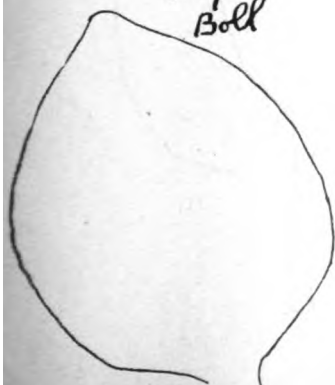
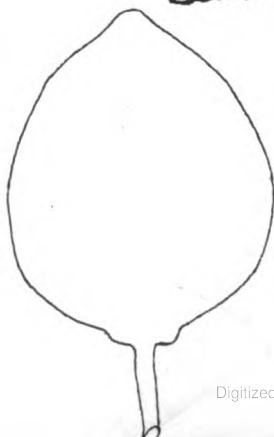


*Lewis  
Prize*

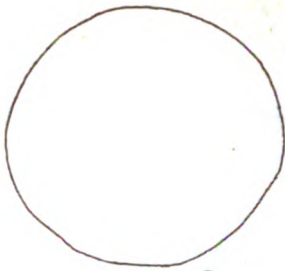


*Louisiana*

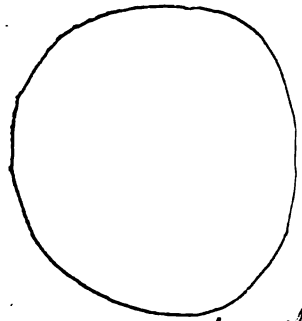
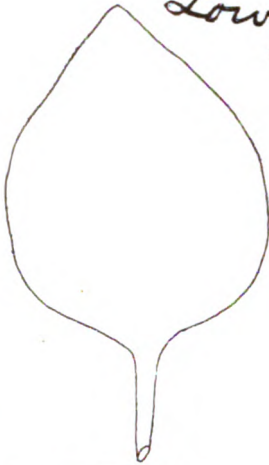


*King**Layton**Langford's  
Big  
Bell**Lealand*

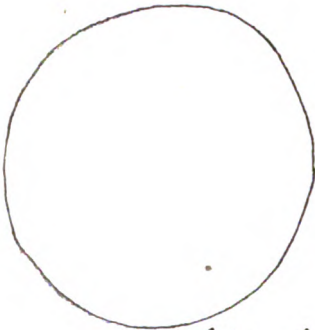
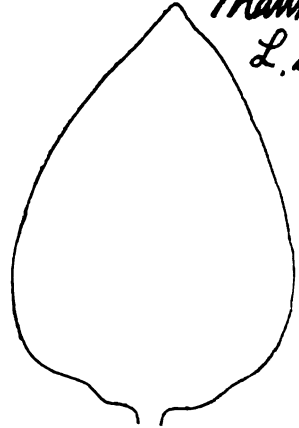




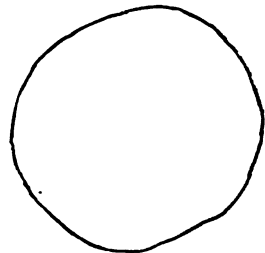
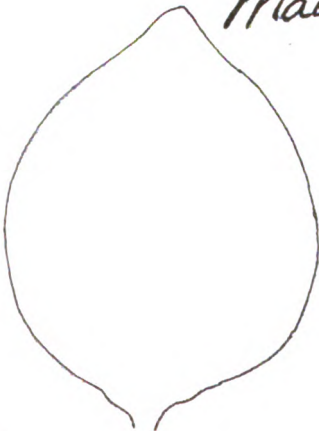
Lowry



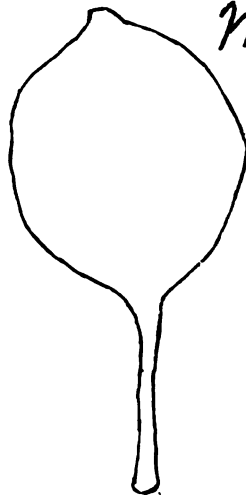
Matthew's  
L.S.



Maddox

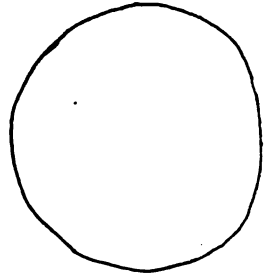


McCall

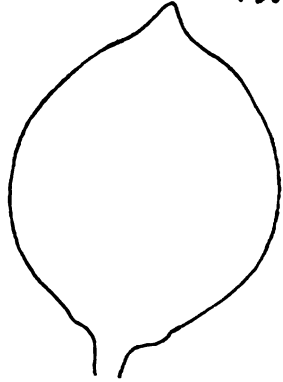
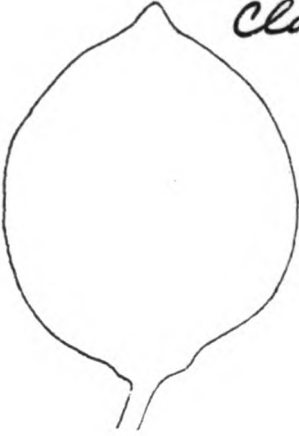




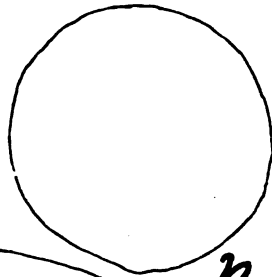
Mont  
Clare



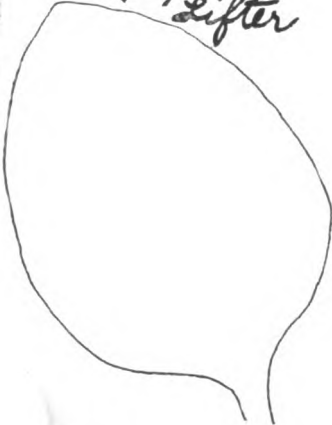
Moss



Mortgage  
Lifter



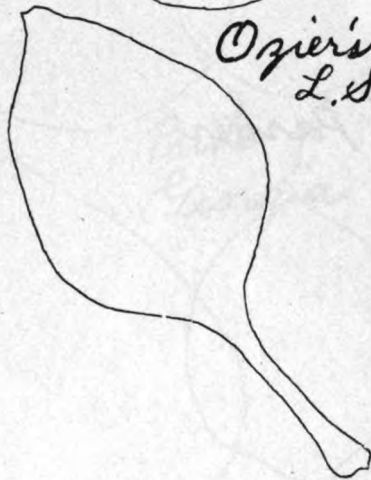
New  
Century



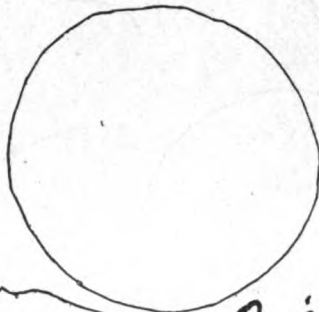
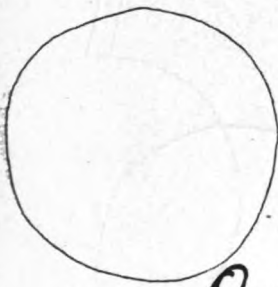


Ozier's  
L.S.

No. 148

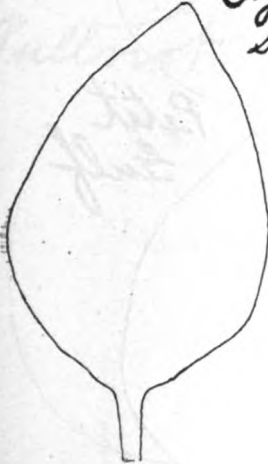


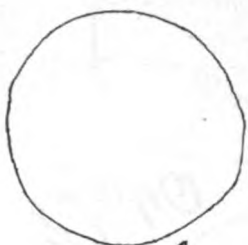
Dixie Wilt-Resistant.



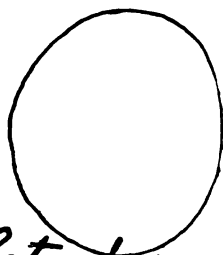
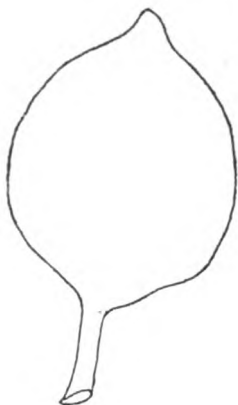
Ozier-  
Starnes

Ozier's  
Big  
Boll

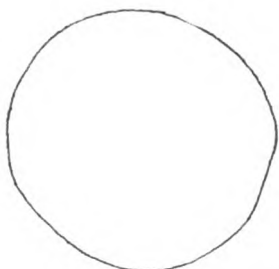
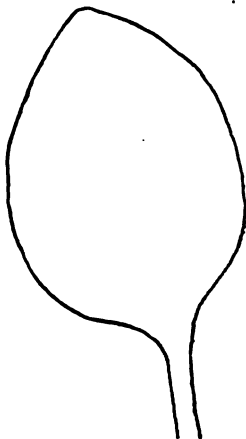




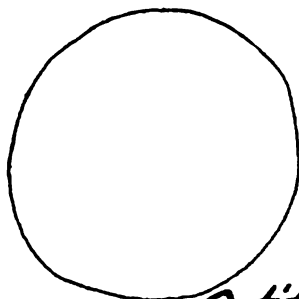
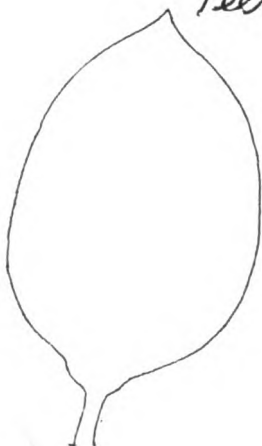
*Parker*



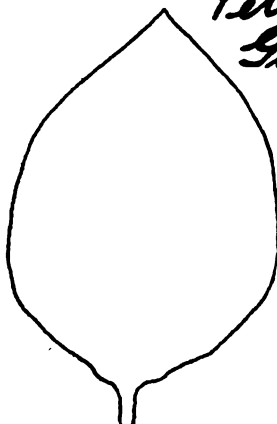
*Peterkin*



*Peerless*

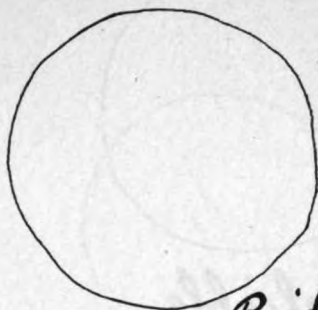


*Petit  
Gulf*

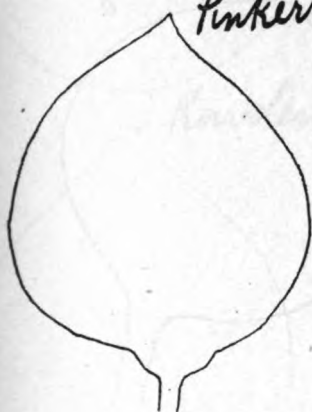




*Pinkerton*



*Pride of Georgia*

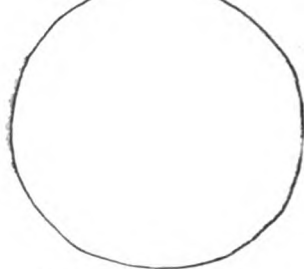


*Pullnot*

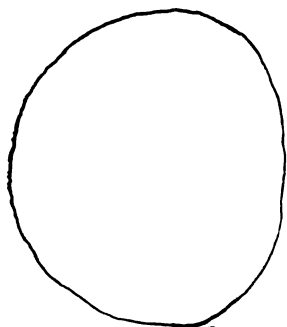


*Red Leaf*

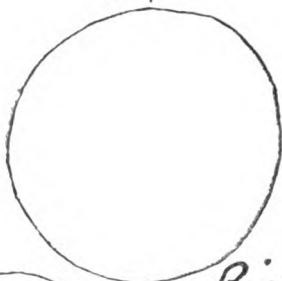
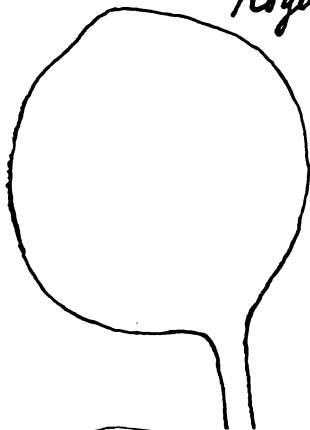
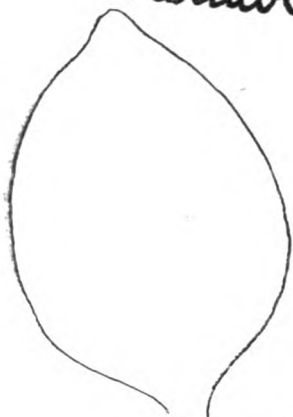




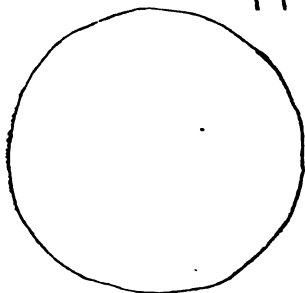
*Reliable*



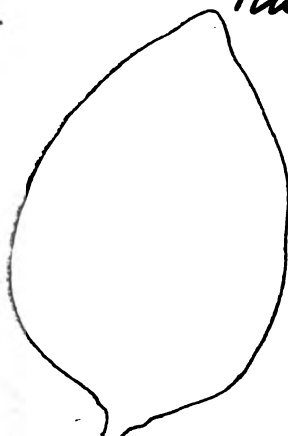
*Rogers*

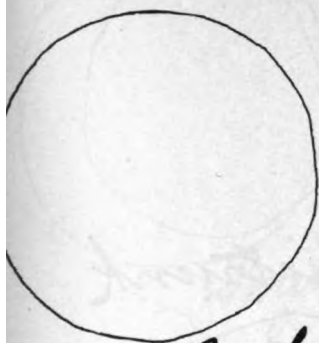
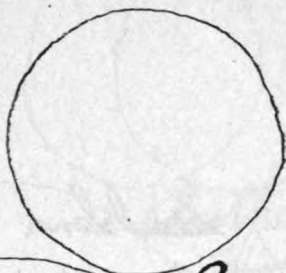
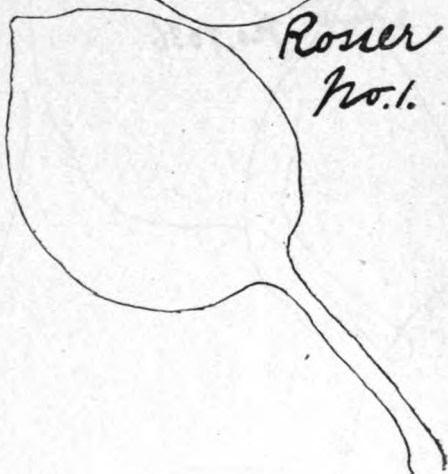
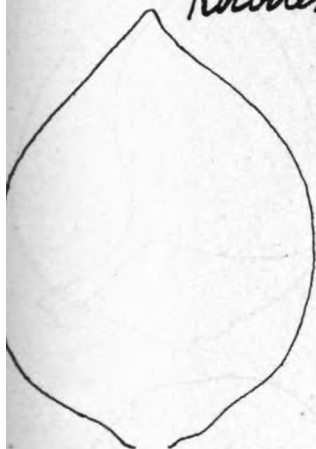
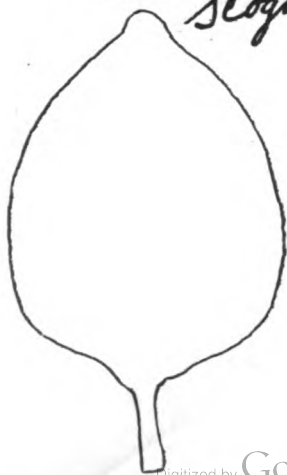


*Rich  
Man's  
Pride*



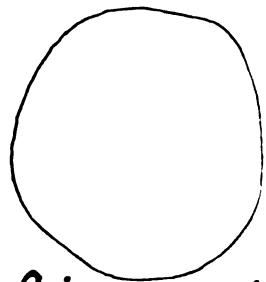
*Russell*



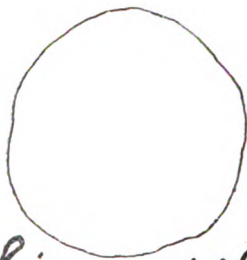
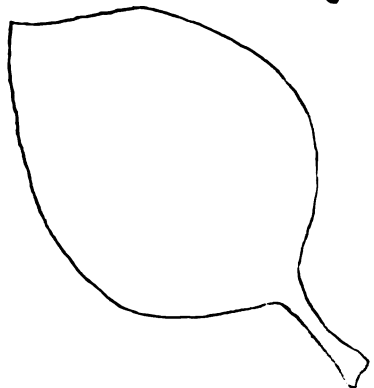
*Rowden**Roser  
No. 1.**Ruralist**Scogin*



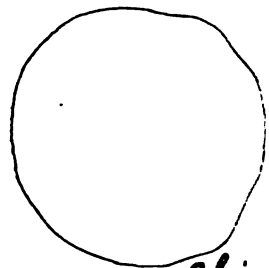
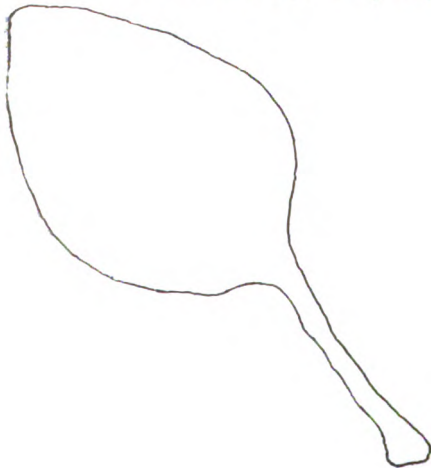
*Sea Island*  
No. 7036



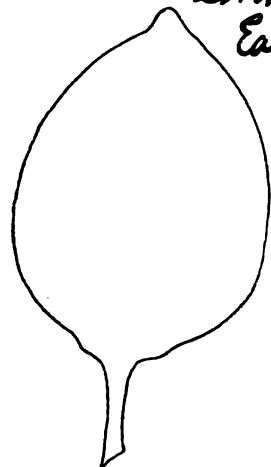
*Sistrunk*



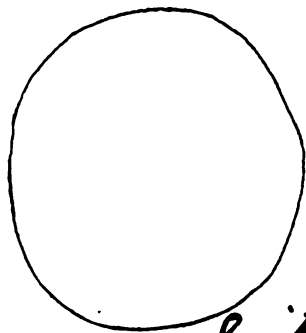
*Simms' L. S.*



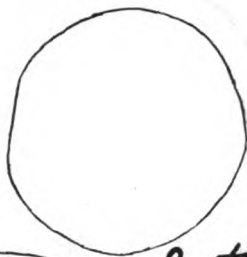
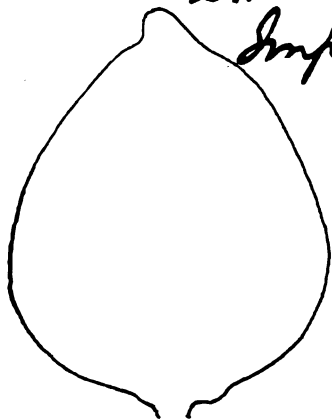
*Shines  
Early*



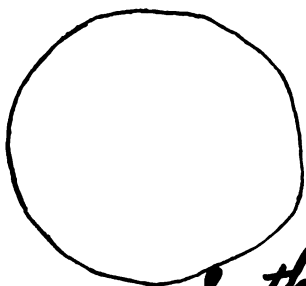




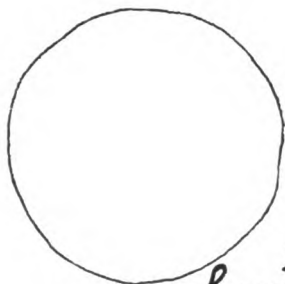
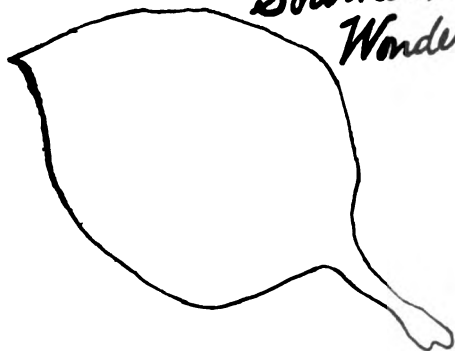
*Smith's  
Impt.*



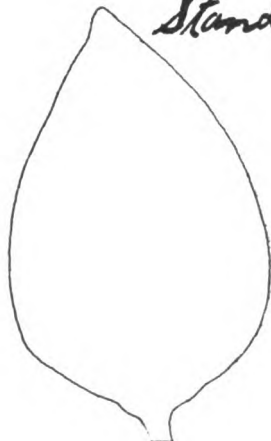
*Southern  
Hope*



*Southern  
Wonder*



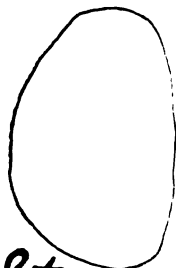
*Smith's  
Standard*



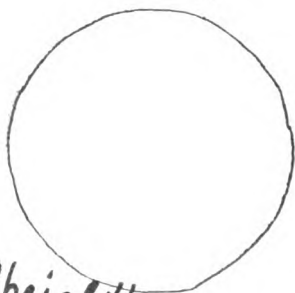
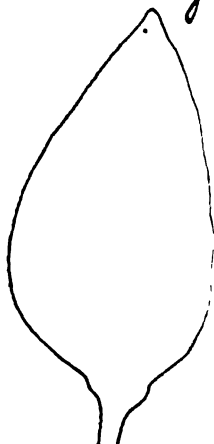
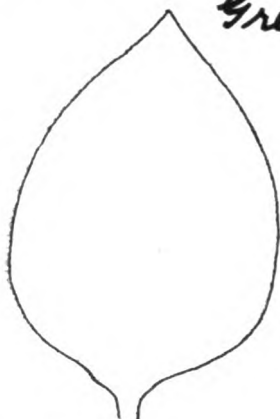


*Spruiella*

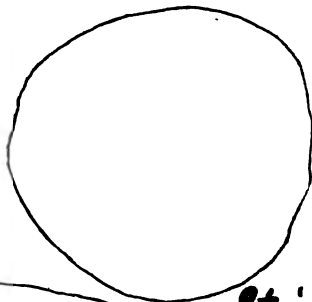
*Early  
Green Seed*



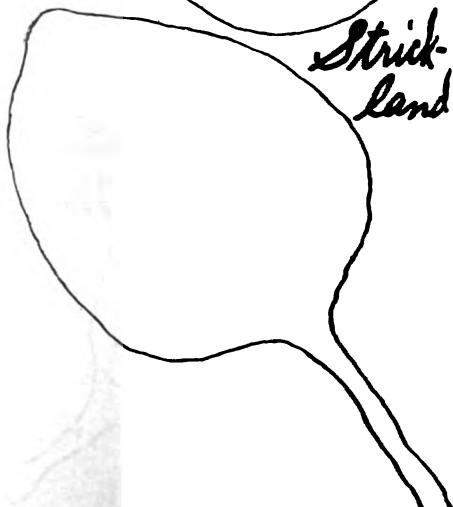
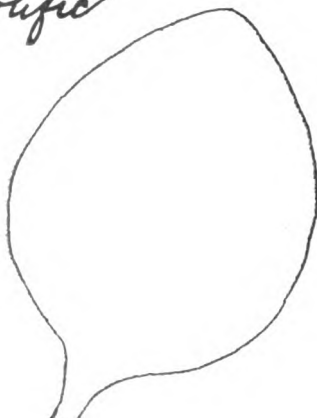
*Sterling*

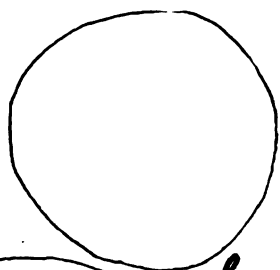
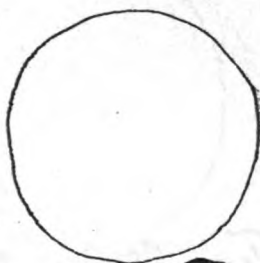
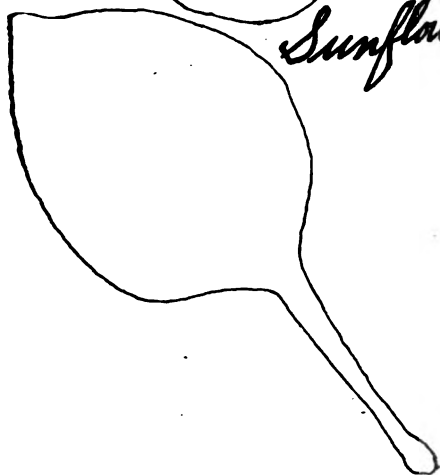
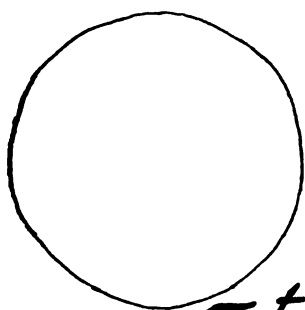
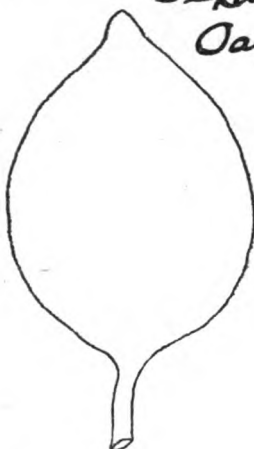
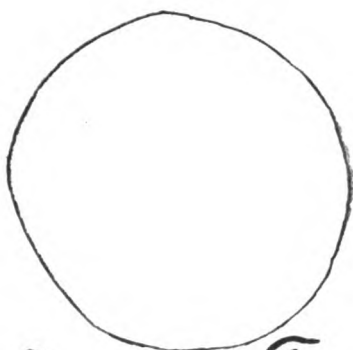
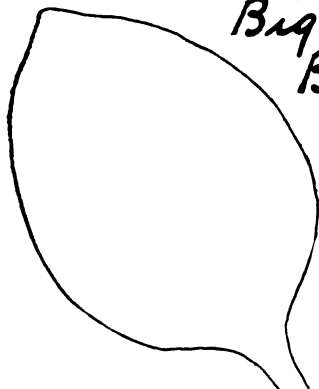


*Speight's  
Prolific*



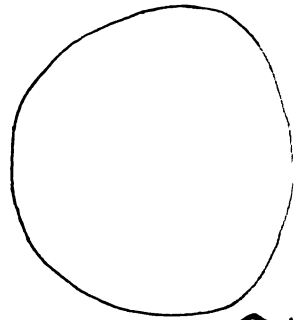
*Strick-  
land*



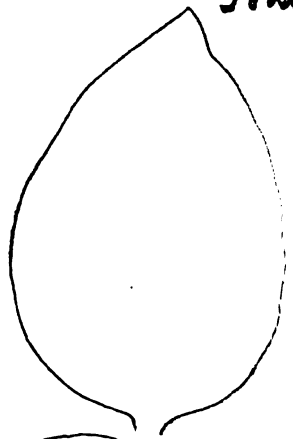
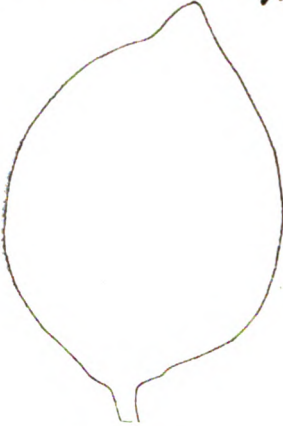
*Sunflower**Texas  
Oak**Tatum's  
Big  
Boll**Texas  
Bur*



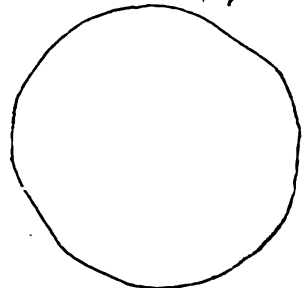
*Tex. Storm Proof*



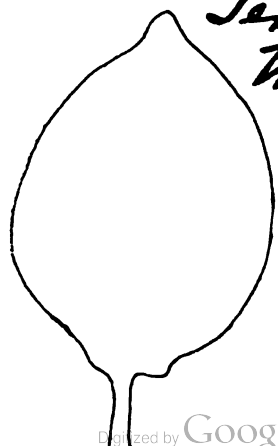
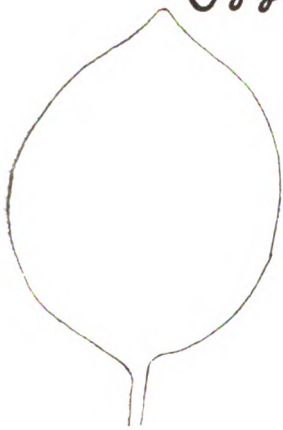
*Toole*

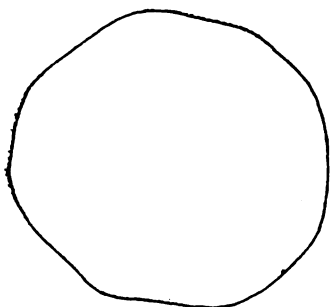
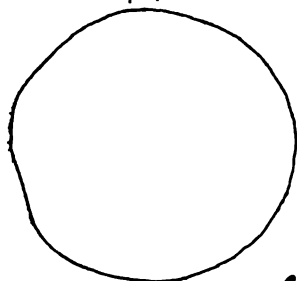
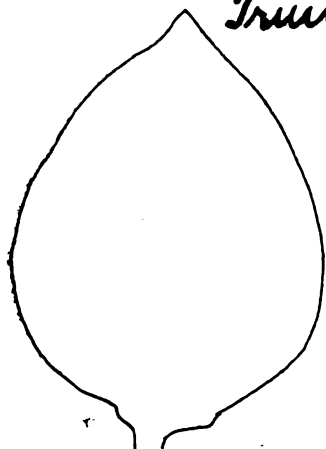
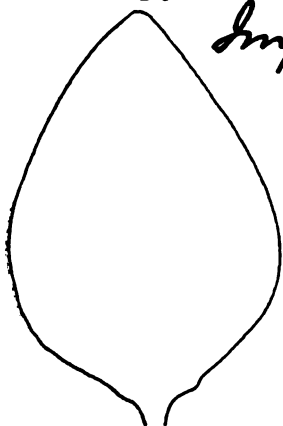
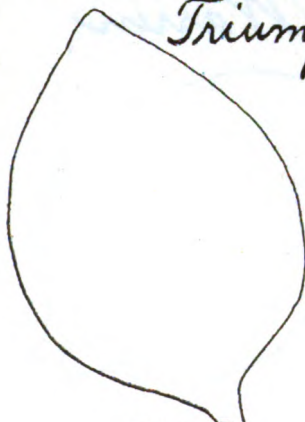
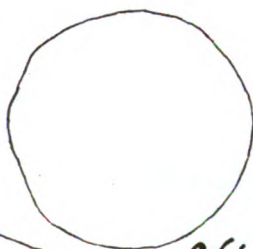
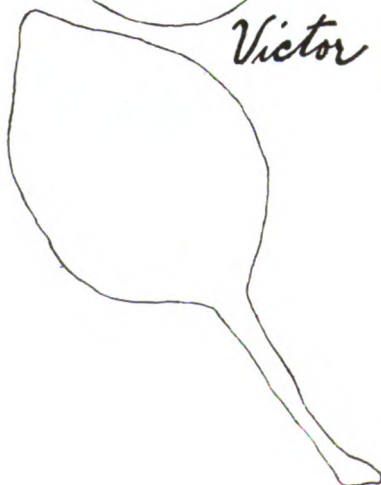


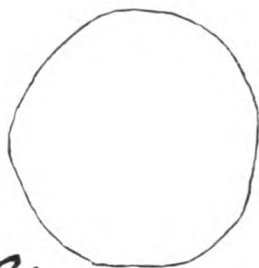
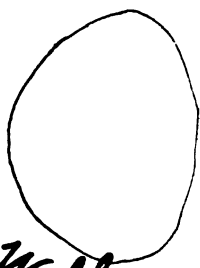
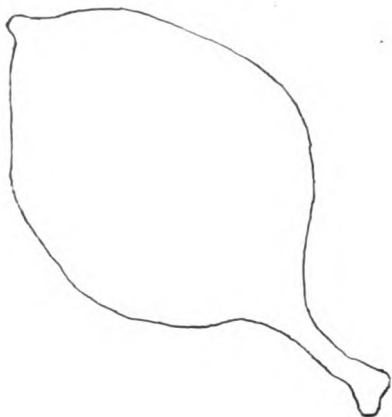
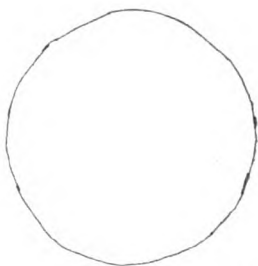
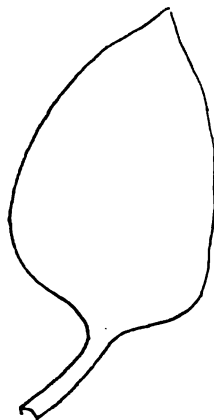
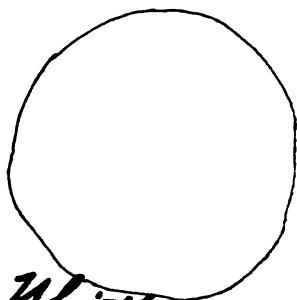
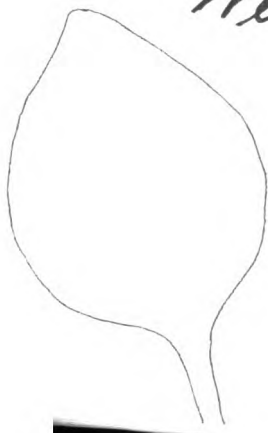
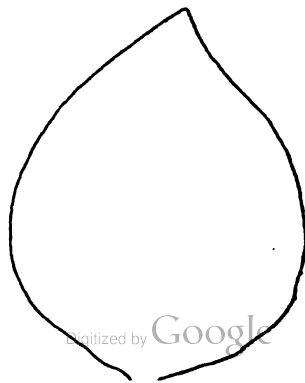
*Toole*

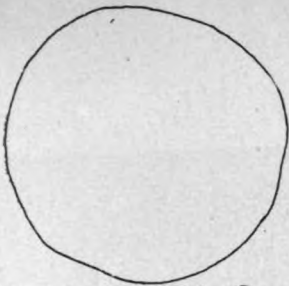


*Texas  
Wood*

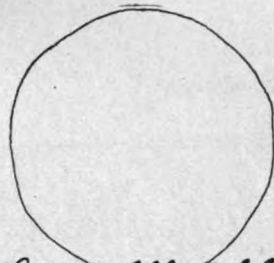


*Truitt**Tucker's  
Impd.**Mebane's  
Triumph**Triumph.**Victor*

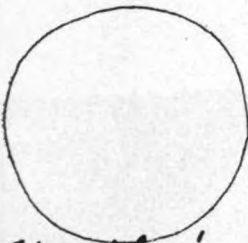
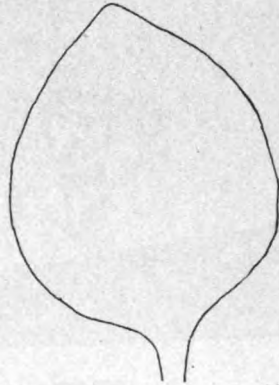
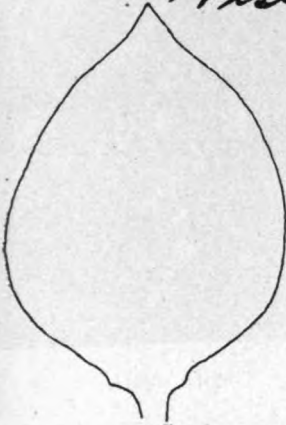
*Warren**Welborn**Webb**Whitten*



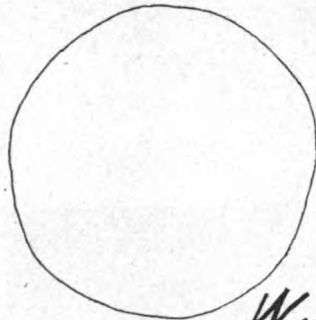
*Wise*



*Wilson's Matchless*



*Woodfin's  
Knapareil*



*Wyche's  
Big  
Boll*

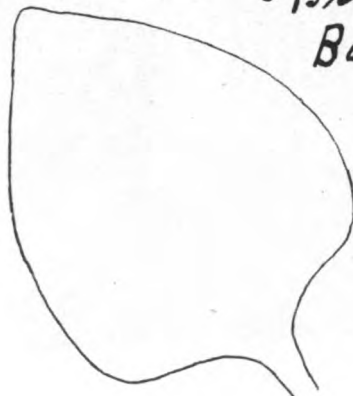
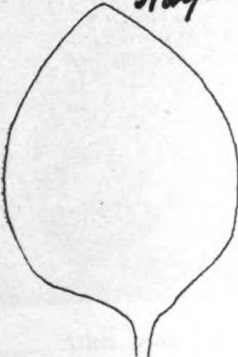
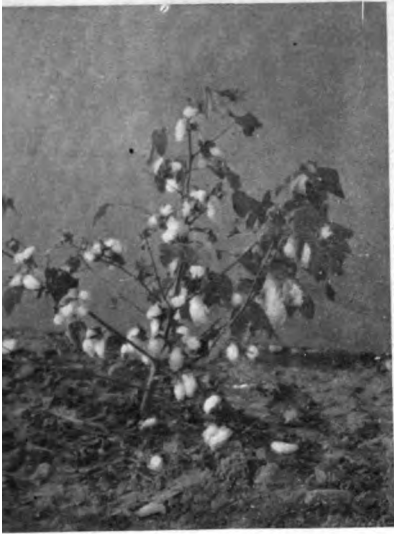






PLATE I.

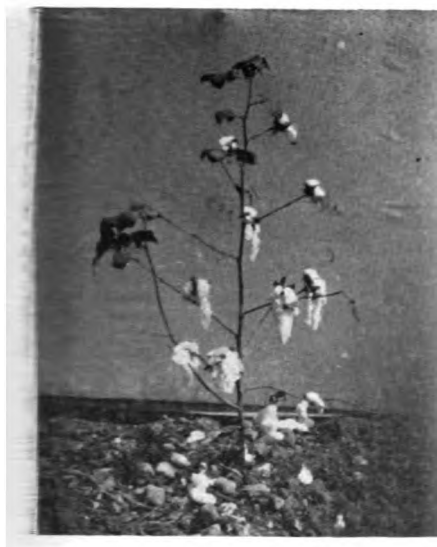


Alex. Allen.

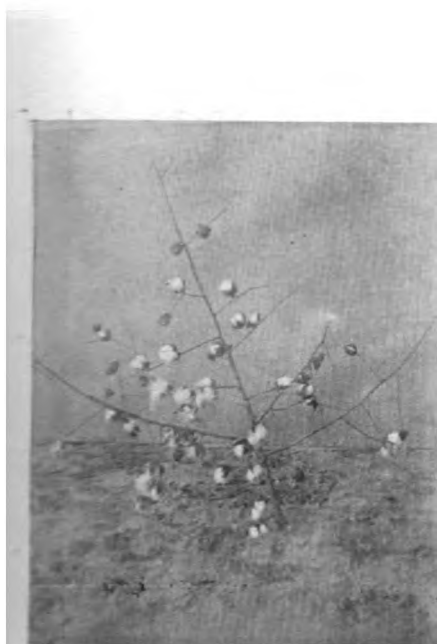


Anderson.



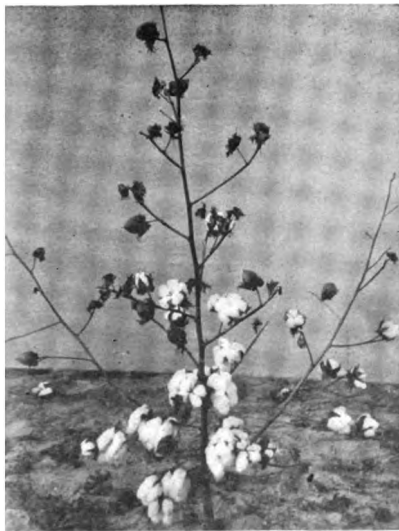


**Bingham.**

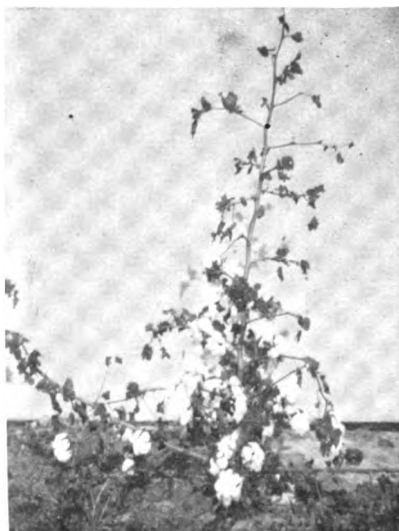


**Black Rattler.**

**PLATE III.**



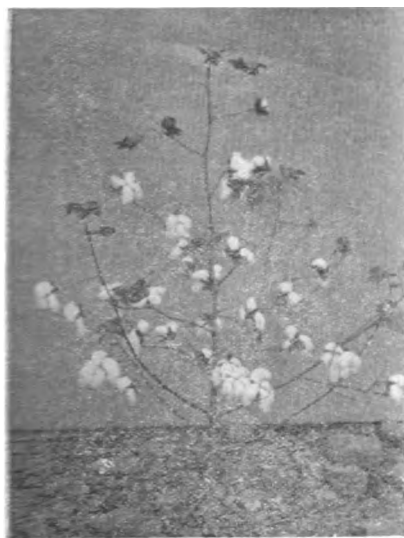
**Blue Ribbon.**



**Boyd.**

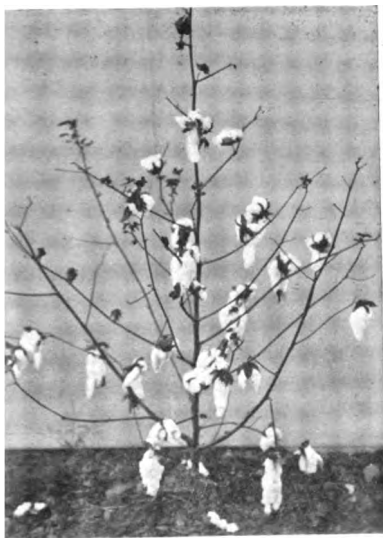


**Breedon.**



**Brown No. 1.**

**PLATE V.**



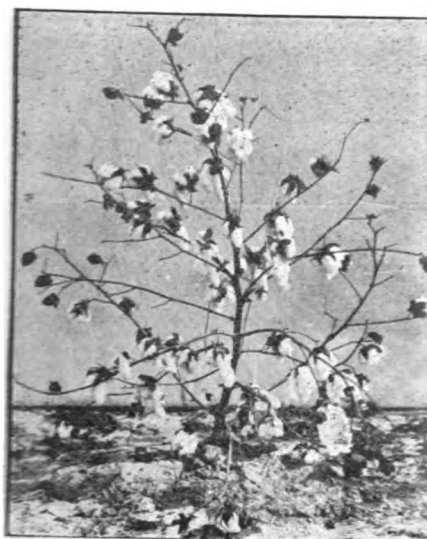
**Butler.**



**Cameron.**



**Combination.**

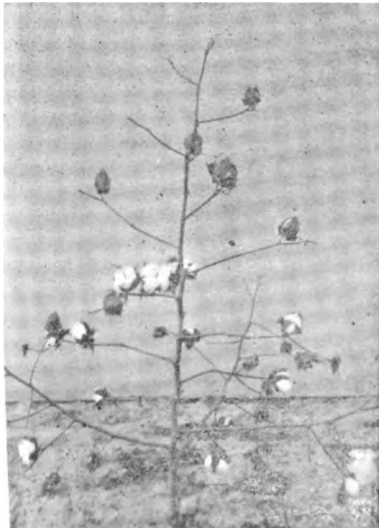


**Cook Improved.**

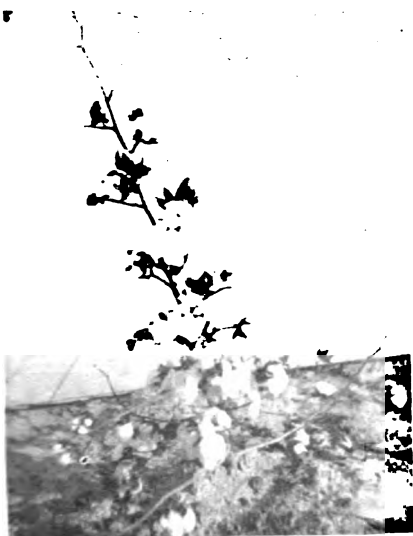
**PLATE VII.**



**Cook Long Staple.**



**Crossland.**



**Dickson.**



**Dixie.**



**PLATE IX.**



**Dongola.**



**Double Header.**

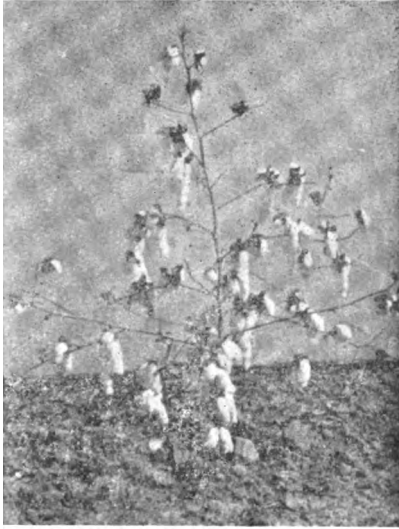


**Edgeworth.**

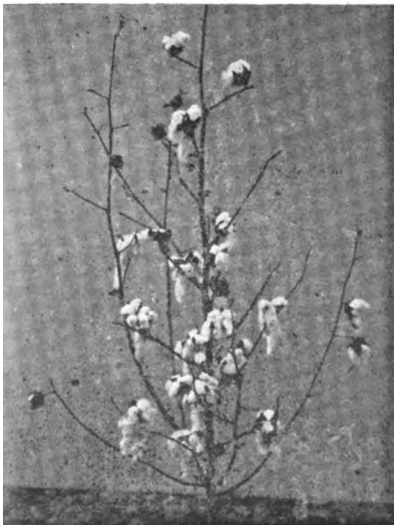


**Eureka.**

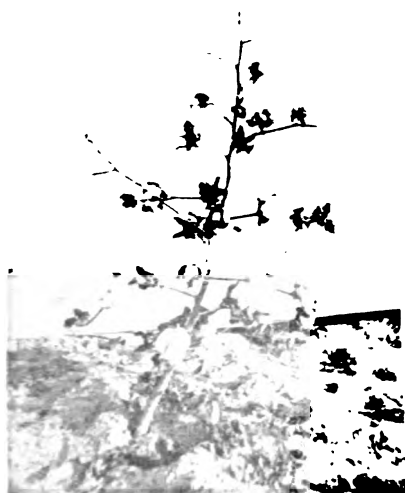
**PLATE XI.**



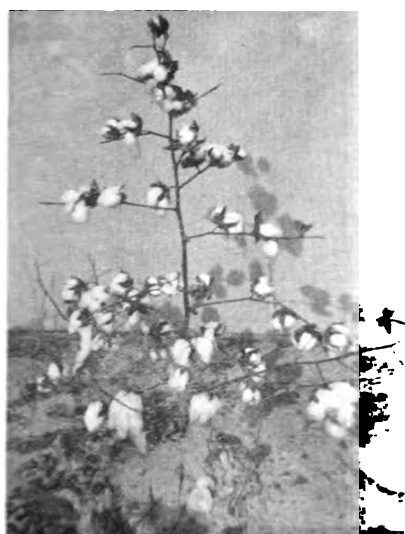
**Excelsior.**



**Extra Early.**



**Garrard.**

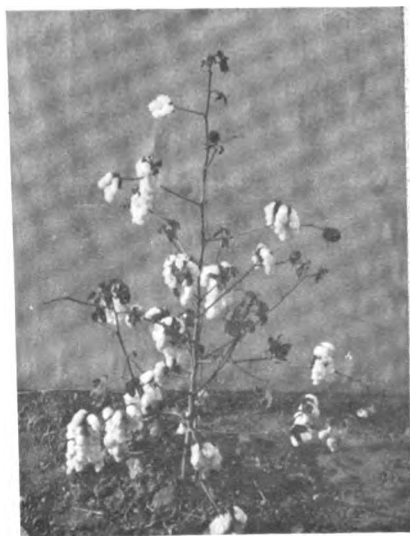


**Gayosa Prize.**

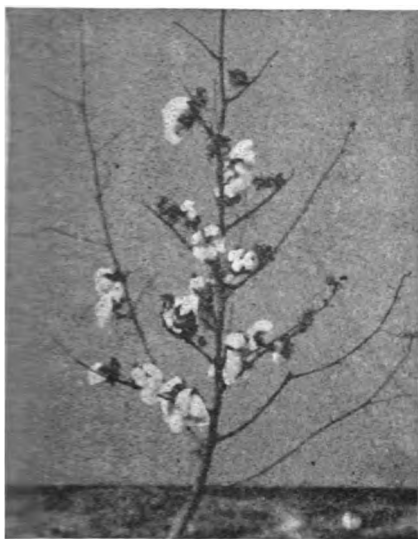
**PLATE XIII.**



**Gholson Long Staple.**



**Gold Standard.**



Harden.

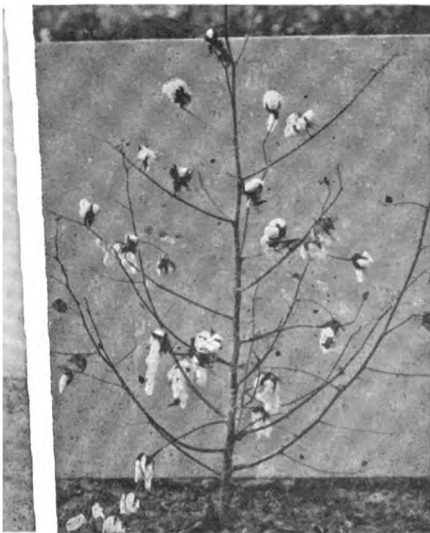


Haralson.

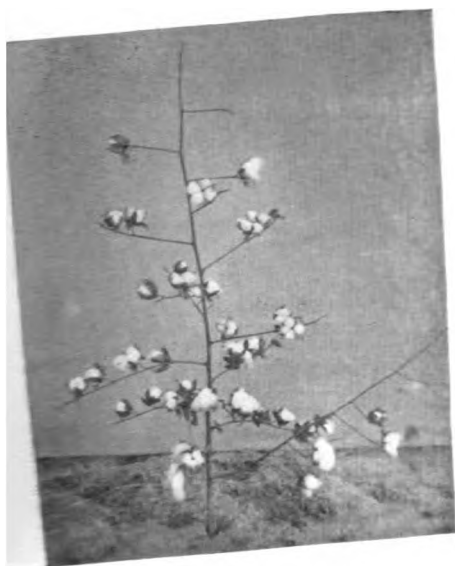
**PLATE XV.**



**Herndon.**



**Hodge.**



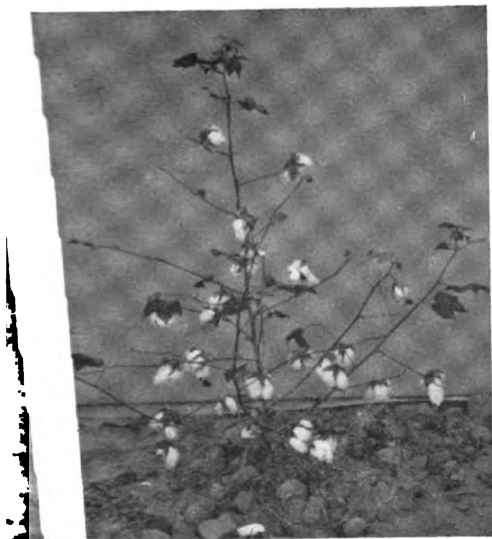
Keno.



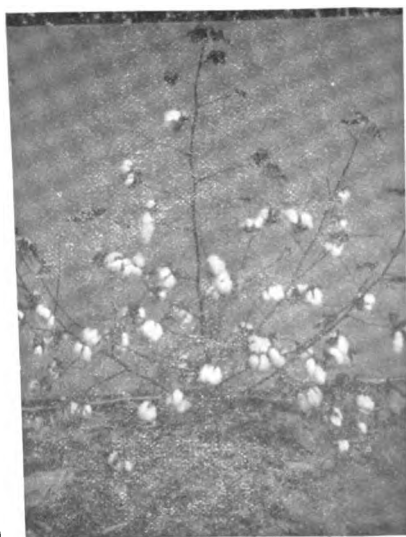
King.



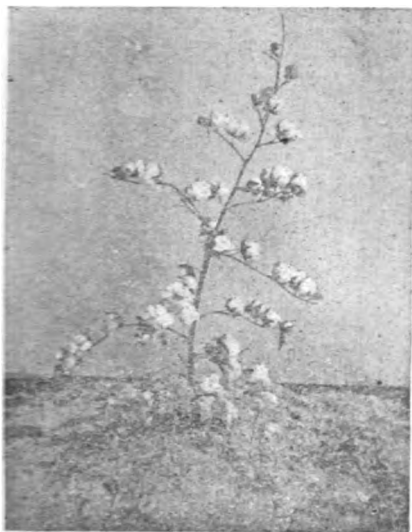
**PLAT XVII.**



**King No. 2.**



**King No. 3.**



**Lewis Prize.**



**Louisiana.**

**PLATE XIX.**



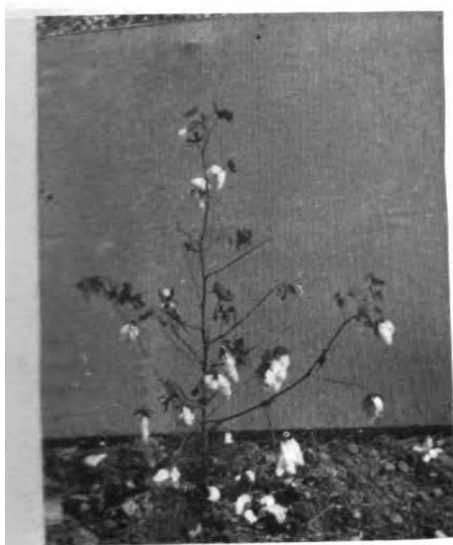
**Maddox.**



**Mattis.**



**Missionary.**



**Mitchell.**

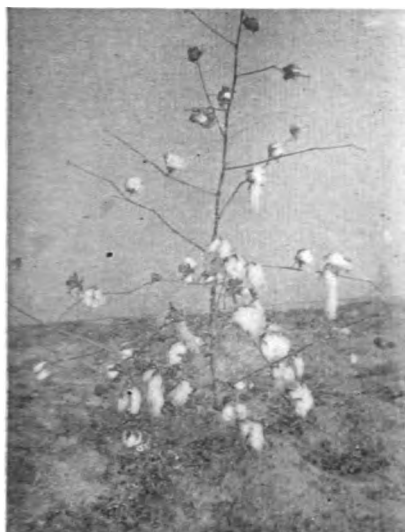
**PLATE XXI.**



**Mortgage Lifter.**



**Montclare.**



**Ozier Starnes.**



**Parker.**

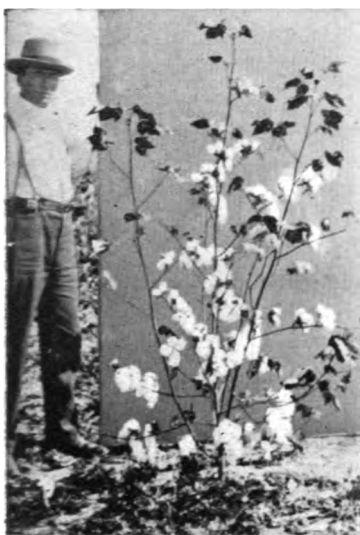
**PLATE XXIII.**



**Peerless.**



**Peterkin.**



**Red Leaf.**



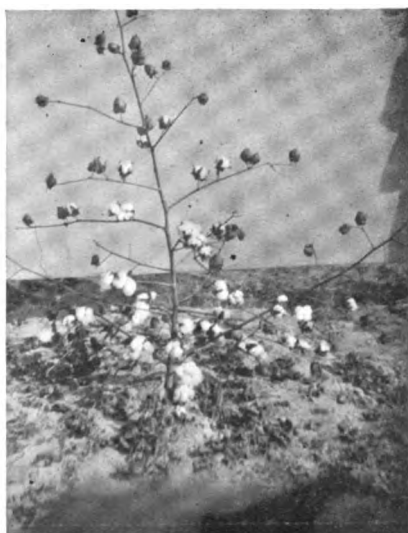
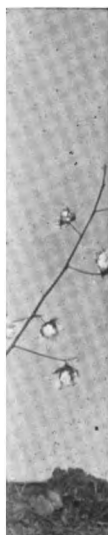
**Reliable.**



**PLATE XXV.**



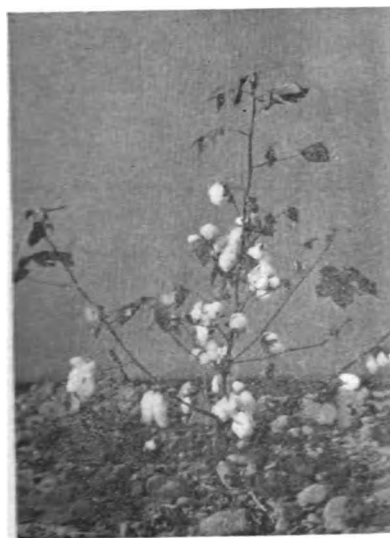
**Rich Man's Pride.**



**Roby.**



**Ruralist.**

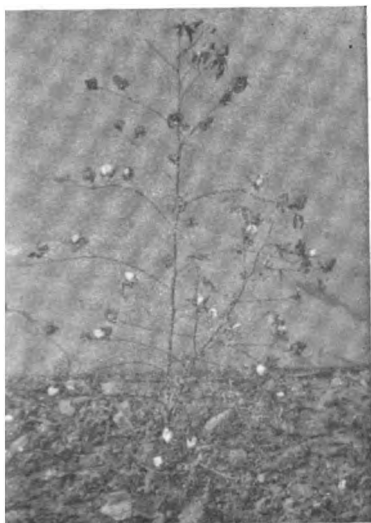


**Schley.**

**PLATE XXVII.**



**Scogin.**



**Sea Island.**



**Shine No. 2.**



**Smith Improved.**

**PLATE XXIX.**



**Smith Standard.**



**d.**

**Southern Wonder.**



**Sterling.**

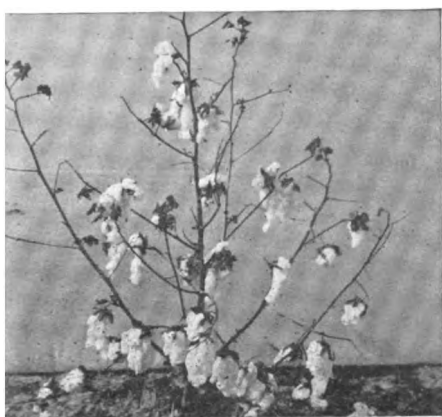


**Strickland.**

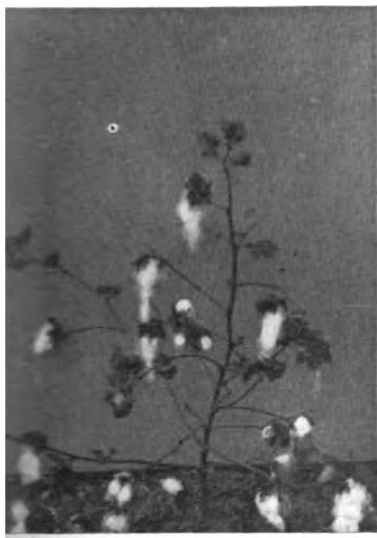
**PLATE XXXI.**



**Sunflower.**



**Tatum.**



**Todd.**



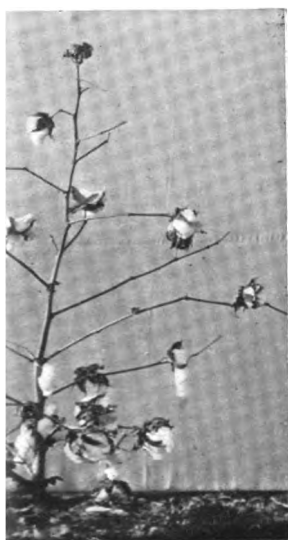
**Toole.**



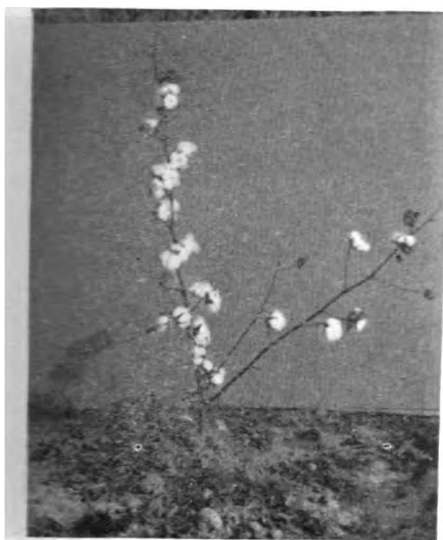
**PLATE XXXIII.**



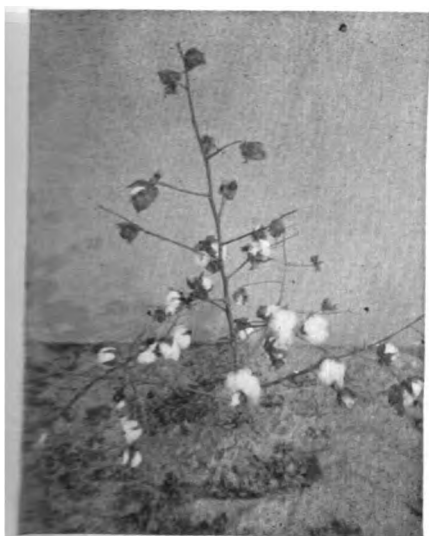
**Triumph.**



**Truitt.**

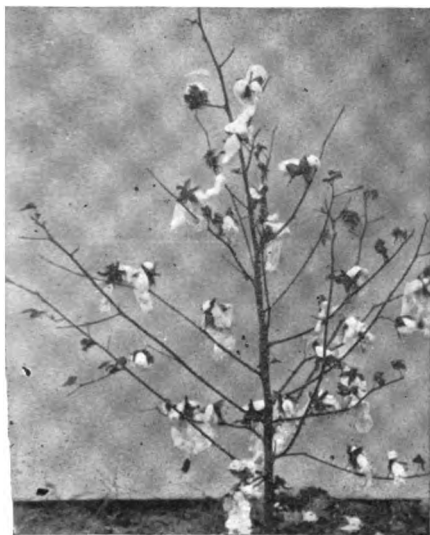


**Welborn.**



**Whitten.**

**PLATE XXXV.**



**Wilson.**



**Wise.**

**BULLETIN NO. 141**



**A L**

# **Agricultural**

**Alabama Po**

**AG**

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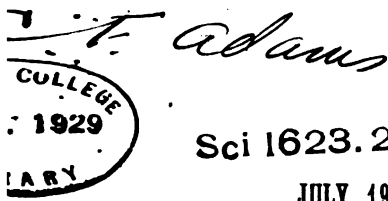
**Texas or**

—

**C.**

—

**OPEN  
THE POST**



Sci 1623.25,4

JULY, 1907

B A M A

## Experiment Station

OF THE

Agrotechnic Institute

BURN-

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· Tick Fever

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BY

A. CARY

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SELMA, ALA.  
ST. PUBLISHING CO.  
1907

## TICK OR

C.

### HISTORY

Tick or Texas fever has been found in parts of Europe, Asia, and America by the Spaniards in the Indies, South America and the United States it came by way of Mexico close of the eighteenth century. In Adams County, Pennsylvania, it was first introduced from North Carolina. It was a destructive and serious outbreak in Texas and in the state of Texas cattle were trail-blazed with it the name Texas fever was given because Texas is in no way free from it tick is the only real cause of the fever.

In 1889 Theobald Smith of the Army Medical Department, discovered that the blood of cattle sick with Texas fever and 1890 Kilborne found that the tick was the carrier of the disease from the healthy cattle. In 1891 in Missouri, and Francis Smith in Texas blood inoculation experiments were successful. Dalrymple in Mississippi, Butler of North Carolina, Willoughby of Georgia, and in Alabama, successfully produced relative immunity in susceptible cattle. In 1892 attempts were made to introduce the disease in cattle by inoculation.

# TICK OR TEXAS FEVER.

BY

C. A. CARY.

## HISTORY OF TICK FEVER.

Tick or Texas fever has existed in cattle for centuries in parts of Europe, Asia and Africa. It was brought to America by the Spaniard, who infested first the West Indies, South America and next Mexico. Into the United States it came by way of Florida and Mexico. Near the close of the eighteenth century, it appeared in Lancaster County, Pennsylvania, resulting from a shipment of cattle from North Carolina into that State. But the extensive and serious outbreaks of this fever first occurred in Texas and in the states and territories over which Texas cattle were trailed toward the north. This gave it the name Texas fever. Better to call it tick fever because Texas is in no way responsible for it and the cattle tick is the only real carrier of the primary cause of the fever.

In 1889 Theobald Smith, then in the Bureau of Animal Industry, discovered the intra-corpuscular parasites in the blood of cattle sick or dead from tick fever. In 1889 and 1890 Kilborne found by field tests that the cattle tick was the carrier of this micro-parasite from the sick to the healthy cattle. From 1895 to 1900, Connoway of Missouri, and Francis of Texas, inaugurated the first blood inoculation experiments that were in any degree successful. Dalrymple of Louisiana, Roberts of Mississippi, Butler of North Carolina, Nesom of South Carolina, Willoughby of Georgia, Dawson of Florida, and Cary of Alabama, successfully employed blood inoculations to produce relative immunity to tick fever in non-immune or susceptible cattle. It might be well to say that many attempts were made to produce immunity to tick fever in cattle by inoculations with blood serum, and by artifi-

the micro-parasite to the from these eggs carry to or calf upon which the time seed ticks molt, or calf may have a high pass through the old fe ticks to get from one sic ox or calf. When the r of a cow, ox or calf whi tick fever, the newly in fever in six to ten days the destruction of red b broken up or disintegr the coloring matter of urea, carbon dioxide a must be eliminated or by way of the lungs, ki cess of waste products number of red corpuse tion of the body as to liver, spleen, kidneys, l of the fever, the red c thrown off by the kid red in color.

#### THE BLOO

Texas fever is essent tissue are so or pathological cha "red water" so commor and the blood engorg changes occurring in t

When the susceptib the parasite (Piroplas the average condiito northern cattle is, \*Hb white cells 5,486 with

\* Dimock and Thomp  
1. This article on the  
ner, assistant Veterina  
Station.



she lays and the seed ticks  
 ro-parasites to the cow, or  
 ticks feed; and about the  
 their skin, the cow, ox or  
 The micro-parasites thus  
 tick, the egg and the seed  
 ox or calf to another cow,  
 rasites get into the blood  
 ot had a severe attack of  
 ow, ox or calf will have  
 ver comes as a result of  
 uscles or cells which are  
 the waste products are  
 od, organic substances,  
 . The waste products  
 t of the animal's body  
 1 and bowels. The ex-  
 od and an insufficient  
 1rb the natural condi-  
 r, and changes in the  
 owels. In acute cases  
 erial of the blood is  
 n the urine is blood

#### FEVER.1

of the blood in which  
 ly constant lesions  
 hemoglobinuria or  
 cases of Texas fever  
 both the result of

st inoculated with  
 by the seed tick,  
 as determined in  
 red cells 6,152,619,  
percentages of the  
 ev. August, 1906.  
 by Dr. Ward Gilt-  
 I. and Experiment

Drs. Connaway and Francis test with the hematokrit in a relation between the temperature changes. The hematokrit is a means of determining the volume of red cells will vary in cases where many microcytes; the reading will be very low while it might be comparatively high to go into an extended criticism when its use is limited to volume. It is unable to establish any very accurate volume of red cells and the hematocrit, although, of course, in a given erythrocytes is more or less of fever.

A careful review of the literature fails to show that the blood is terminated by the hematocrit only with the temperature curves. There are comparisons by acute stages of the fever with 106 Fah., the red cells show a cent. while, during a later recovery, a temperature of 104 Fah. is attended by a destruction or the reverse may be noted. There are serious and constant variations in a fever. An examination of the records (made in this case of Texas Fever (i. e., *C. burnetii*) shows that there is no typical curve.

A study of the Piroplasma shows interest and profit. The infection is undoubtedly very rapid after the attack of the red corpuscles.

---

\* Drs. Connaway and Francis, Expt. Station.

is\* made a very extensive attempt to find some relation curve and the blood absolutely unreliable as a bar of red cells, since the with the size. In certain re present the hematokrit he actual number of cells It is hardly worth while of the hematokrit even ric analysis. They were ite relation between the iations in temperature, l way the volume of eased during an attack

of Smith and Kilborne in Texas fever as de- rresponds at all close- ll sorts of irregulari- method. Often in the emperature of 105 to action of only 20 per iding either death or rees to 102 degrees high as 75 per cent., fact remains that alterations and in- about 200 tempera- it) in experimental blood inoculation) ture curve.

im is not without ie parasite is un- e into the blood. ing them so much  
Co. 48, Mo. Agri.

toxin that might be utilized at least a passive immunity results of their experiments. The serum contains no toxin and physiological effects follow ties, while it evidently contains use has no effect in lessening frequent or impending attack.

Dalrymple, Morgan, and I  
tion were able to confirm th  
that the serum has no cura  
tack has begun. In practice  
ture i. e., the transfusion o  
material is secured from a  
one that has passed through  
least has or has had ticks o  
that in the ordinary immune  
parasite to several million co  
to one to fifty in fatal cases.  
fatal cases the parasite is set  
occurs there in many of the ir  
in such cases and taken fro  
doubtedly serve the same pur  
as the entire blood, and it is  
where the red cell destructi  
blood may contain extra-corp  
is doubted by Smith.

The number of corpuscles 1 per cent., but if this number usually attend. If recovery takes sides, the number of parasites writer have found Wright's demonstrating the Piroplasm of time to hunt and a mechanical search, it is better to await a from the heart muscle, kidney

August Mayer, having had experience with the ticks, made

d practically in stimulating in susceptible cattle." The along this line indicates that substance since no untoward its use in enormous quantities contains no antitoxin, since its is the severity of a subsequent the fever.

odson of the Louisiana state results and show further the properties after the actually all the work of this n-blood or blood serum, the so-called "immune" cow or on attack of the fever or at her. Schroeder estimates cattle there is not over one uscles. This may increase as shown by Dr. Smith, in ee in the blood plasma and rnal organs. Blood serum such sources would use in producing immunity ssible that in some cases is severe, the peripheral al parasites, though this

ected often reaches  $\frac{1}{2}$  to is exceeded fatal results s place as the fever sub-reases. Dr. Cary and the n most satisfactory for d unless one has plenty l stage to assist in the case and secure smears iver.

disastrous personal ext a strong case against

intense heat, severe exertion, certain undetermined factors, the animal's resistance; or, on the other hand, a considerable increase in the animal's resistance, suffice to bring about the attacks of the fever. Many of the soundness of this theory come from the South, south of the line. The suggestion by some one in the South that the blood of a herd of ticks taken from the ticks secured in such an interesting comparison with that of northern cattle.



FIG 1.—Boundary line of  
(From Bureau of)

#### LIFE HISTORY

The large, fat female tick, after taking blood from its host, hides under leaves, litter or in other places. A few days begins to lay eggs. It may lay 1,500 to 4,000 eggs. The egg gradually shrinks in size.

adverse change of blood, or tending to lower the another hand, a slight or connumber of the invading oracute and often fatal at- as can be recalled to prove

Northern cattle can not cattle can not stay safely Schroeder is timely, that extended examination of ted cattle. The blood pic- gation would make an in- sults at hand on the blood



affected with Texas fever. (Industry Bul. 258.)

#### CATTLE TICK.

completely filled with to the ground, crawls manure heaps and in a six to fifteen days she e female lays eggs she a few days after lay-



**A tabulated statement of the  
tick for summer and winter may**

**SUMMER.**

<b>May to October.....</b>	<b>Oc</b>
<b>1. Egg laying time—6 to 15</b>	
days .....	3
<b>2. Hatching time—12 to 30</b>	
days .....	3
<b>3. Seed tick may live with-</b>	
<b>out getting on cattle,</b>	
<b>horses or mules 30 to 120</b>	
<b>days.</b>	
<b>4. After attaching to the skin</b>	
<b>of cattle, females mature</b>	
<b>and drop off in 15 to 35</b>	
days .....	

---

**EXPLANATION**

1, larva of cattle tick ( $\times 25$   
mature female and eggs; 4, hi  
blood cells containin  
( $\times 1,000$ ); 6, male cattle tic  
size); 8, young female cattle t  
size); 10, various stages of cat



e life history of the cattle  
y be stated as follows:

WINTER.

ober to May.

to 60 days.

to 210 days.

to 240 days.

60 days.

FIGURE 2.

me (natural size); 3,  
wing cattle ticks; 5,  
exas-fever protozoa  
, 7, same (natural  
5); 9, same (natural

## SYMP

1. The presence of lead one to expect si quently the ticks are can not see or find th applied to a non-imm or calf may have a may not be seen or f Look closely and fee on the escutcheon, on the body.

2. Determine the mals. Have they be a tick infested one? into the pasture? St and non-immune. M susceptible. All very cattle from above the tick free places or fa

3. The temperatur changes occur in the i from 101 to 103 deg from 103 to 107. T night or late afterno temperature may con then drop to the nor variable periods of temperature. Just l and sometimes to sub

4. The appetite is and capricious in chr pended in acute cases begins.

5. The bowels may pension of rumination cate that the function pended. The lining c may be more or less

### OF TICK FEVER.

Small ticks or large ticks should not be taken as evidence of tick fever. Fre-  
quently all that the ordinary observer  
sees is that the ordinary observer  
Twenty-five infected seed ticks  
may produce tick fever. A cow  
infested with seed ticks on it and they  
noticed by an inexperienced observer.  
usually on the inside of thighs,  
abdomen, drew lap and all over

any of the sick animal or ani-  
mal brought from a non-ticky place to  
where ticky cattle have been brought  
ticky cattle are usually free of ticks  
own cows are tick free and  
calves are susceptible. All  
entire line and all cattle from  
are susceptible to tick fever.

Before any other noticeable  
animal. The normal ranges  
normal and the fever will range  
temperature will be higher at  
in the morning. The high  
for two to ten or more days,  
in chronic cases there may be  
and falling of the animal's  
death the temperature falls

acute cases and is variable  
s. Rumination is also sus-  
not resumed until recovery

five. Loss of appetite, sus-  
ceptibility of the bowels indi-  
cates alimentary canal are sus-  
ceptible and fourth stomach  
and the inactivity may be

around with head down and  
come separated from the r  
the shade and are fond of

11. Some cases become  
violent. This is due to in  
of blood to the brain or to  
from the stomach or intes  
inability to see may also be

12. An animal in fairly  
flesh and becomes tucked u

13. Cows will often ab  
or sometimes after a chron  
lose their vigor and are ofte  
or two years.

14. A small swelling may  
or between the branches of t  
present in chronic cases and  
a cough.

#### DIAGNOSIS OF

1. The positive test is fi  
the red blood cells. This is  
the animal dies, because it  
plasma is found in the blood  
sufficient numbers to be easi  
smears of the blood taken fr  
kidney will usually contain  
parasites. The blood may be  
line methyl blue after it has  
110 to 120 degrees C. for 2 h  
main on the slide for one t  
wash in water and then dip  
third per cent. acetic acid so  
of diffuse stain in the red blo  
mount in water or dry and mo  
examine by using immersion

With Wright's stain the bl  
ing; keep the stain in the sli

k arched, and usually be-  
f the herd. They prefer  
ding in the water.

and somewhat crazy or  
ient or improper supply  
ption of toxic materials

A wabbling gait and  
ent.

condition rapidly loses  
he abdomen.

ring or after an acute  
ck of the fever. Bulls  
ss for breeding for one

ir under the lower jaw  
r jaw. This is usually  
erally associated with

#### FEVER.

he micro-parasite im  
difficult to do before  
often that the piro-  
: skin or subcutis in  
quickly found. Slide  
heart muscle or the  
is intra-corpuscular  
with Loefflers alka-  
ed by heating up to  
he stain should re-  
nd a half minutes,  
instant into a one-  
remove the excess  
wash in water and  
balsam or dry and  
e slide.

: will need no fix-  
e to five minutes;

wash with water, dry and examine with high power. The writer was the first one to use Wright's stain in demonstrating the piroplasma of tick fever in the blood of cattle.

2. Black Leg or Black Quarter is often confounded with tick fever. This usually attacks young cattle under two years old and not very young calves or older cattle. It usually attacks fat yearlings instead of the poor ones. Before death and after death there is a swelling over the upper part of a front limb or hind limb or on some part of the body. This swelling crackles when the hand is rubbed over it, indicating the presence of gas under the skin. Cutting open the swelling permits a dirty red liquid to escape and exhibits muscle and connective tissue that appear as if they had been par boiled. Smears from this may be stained and the specific bacteria of black leg may be found. Also the material may be injected under the skin of a calf, sheep or a small laboratory animal and produce the specific disease.

3. Haemorrhagic septicaemia is not unlike a chronic case of tick fever. The presence or absence of the piroplasma will identify the one or the other. This characterized by well defined haemorrhages and numerous haemorrhagic spots under the pleura, peritoneum and epicardium. Sometimes the urine is stained red but not as frequently so as it is in tick fever. This disease is said to be caused by a specific germ (*Bacillus bori-septicus*.) The outbreaks of this trouble are localized.

4. Anthrax may be mistaken for tick fever or the reverse may be true. In this the specific germ, *Bacterium anthracis*, may be found and it attacks horses, mules, cattle, sheep, goats, rarely hogs and occasionally man.

5. Stomach worms and hook worms in the alimentary canal may produce an anaemia not unlike that of chronic tick fever. In this, search for the worms in the feces of the suspected cases. These worms and tick fever may both be present in an animal at the same time.

TABLE I. *A Comparative Study of Four Specific Diseases.*

Disease	Haemorrhagic Septicaemia	Anthrax or Charbon	Black Leg	Tick fever
Cause	Bacillus bovisepiticus	Bacterium anthracis	Bacillus Feseri	Piroplasma bigeminum (a protozoan)
How spread	Unknown	Food, water, flies, carcasses, etc.	Food, water, discharges, carcasses, etc.	Cattle ticks
Extent of single outbreak	Localized	Local centers and wide spread	Local. Often one farm or one pasture	Tick infested areas
Favorable season	Any season	Hot, dry weather after wet spring	Spring, summer and fall, hot and dry	Summer and fall but may occur any season
How germ enters body	Unknown	Digestive tract, lungs, skin	Skin (?)	Tick inoculation through skin
Susceptible Animals	Nearly all	Horses, mules, cattle, sheep, goats, man	Young cattle, sheep, goats	All cattle at some life period
Mortality	Very high	Very high	Very high	High in old cows and low in young cattle
Beginning and course	Acute, sudden. Chronic slow	Usually rapid	Generally rapid	Acute, rapid; chronic, slow
Local swellings	Slight or absent	Acute, occasional; Chronic, frequent	Very marked and gas under skin	Absent usually
Urine	Rarely blood stained	Often blood cells, stained or dark	Rarely blood cells stained or dark	Often blood stained or dark, albumen
Manure	Often blood stained	Often blood and mucus	Constipation and manure bloody	Blood stained, mucus and bile
Blood after death	Normal and clotted	Dark, tar black, clots, slow or slight	Normal, except at swelling	Thin, light in color and clots slowly
Haemorrhages	Often present and clearly defined	Spleen often ruptured	None	Usually none
Serous surfaces	Numerous blood spots on them	Blood spots and red serum in serious cavities	Serum in abdomen	Blood spots on epicardium and endocardium
Spleen	Normal, except surface blood spots	Large, dark and soft	Normal	Very large, soft, blue-black
Liver	Blood spots on surface	Engorged with dark blood	Usually engorged	Engorged with blood and bile
Kidneys	Blood spots on surface	Congested usually	Normal or engorged	Sometimes pale, usually engorged and black
Lymph glands	Blood stained near blood lesions	Often red or black and large	Normal	Slightly enlarged rarely red

### AFTER DEATH CONDITIONS.

1. If the animal was sick for several days, the carcass will show emaciation, but fat animals may die suddenly and then the carcass indicates that the animal was in good condition as to flesh and nourishment.

2. In cutting through the skin it appears pale, as if there were little or no blood in the skin or subcutis. When blood is found in these tissues it appears "watery" or "thin" and does not coagulate readily.

3. The rumen or paunch may contain more or less semi-liquid material. The third stomach or maniforms, usually, in acute cases, contains very dry feed. The mucous membrane of the fourth stomach and of the small intestine will exhibit raw or eroded surfaces or patches. The contents of the intestines may exhibit an excess of bile, some blood and mucous, and the fecal matter may be soft or more or less dry and hard.

4. The spleen is usually enlarged or engorged with blue-black blood. A cut surface will let the contents flow out and it will appear like black-berry jam in color and consistency. This is broken down red blood cells and waste materials of the blood.

5. Kidneys are congested and often enlarged in acute cases. In chronic cases they may appear normal to the naked eye.

6. The bladder may contain red colored urine, dark colored urine, normal colored urine, or be empty. As a rule in a number of cases that die of tick fever, red urine will be found in some of the cases.

7. The liver is usually greatly enlarged and filled with blood and bile having a brown mahogany or yellow color. The gall bladder is distended and the bile is thick with flakes of mucous.

8. The lungs may be congested or may be normal.

9. The peritoneum and pleura may present a few colored patches or haemorrhagic spots or patches. These are not constant.

10. The heart may have the right ventricle "distended



with blood, full or clotted, according to the time elapsing between death and the examination. The left ventricle is usually firmly contracted and may contain a small quantity of fluid or clotted blood." (Smith.) The small haemorrhagic spots under the epicardium and endocardium are quite constant, they are more numerous on the outside and inside of the left ventricle.

11. The subcutaneous tissues, the mucous membranes of the mouth and eyes may become more or less yellow in acute tick fever cases. The fat of the body may be also yellow. The yellow coloring of white tissues is due to an absorption of bile. It is not always present. And yellow fat is not always due to tick fever. In many cases the mucous membranes of mouth and eyes are very pale.

12. Secure smooth slide smears of blood from the kidneys, the heart muscle and the liver. Stain with Wright's stain and examine with high power lens for the intra-corpuscular micro-parasite. Or examine with high power a fresh mount of blood from a kidney or the heart muscle for the micro-parasite.

#### IMMUNITY.

Immunity to tick fever is a relative term. It is not absolute. When an animal is not susceptible to an attack of a given disease, the animal is said to be immune to that disease. Immunity may be acquired by having the given disease one or more times, by natural resistance of certain species of animals for certain diseases, by introducing specific anti-toxins into the animal body. In tick fever, the only known means of producing immunity in cattle is by giving the animal one or more mild or severe attacks of the fever. Blood inoculation, or artificial tick infestation, are the only ways of artificially producing this immunity. Natural tick infestation may also produce immunity in a varying degree. The fact is that a cow, steer or ox must have an attack of tick fever once every year or several times every summer or its immunity is lost within two or more years. Just as a man can have a series of attacks of malaria so may cattle have a series

2. Inoculate any time before the last of March, and all cattle in the South need to be inoculated.

3. For the infected steer or bull that has been inoculated that has had a gross infection the second summer of the year.

4. Secure a sterilized hypodermic needle (2 to 3 drams) having a sharp scalpel knife, three or four breakers or wide mouthed rod or small sterile syringe some 5 per cent. creosote.

5. Every animal should be haltered in a narrow

6. Cast the two yokes and be drawn or secure in a hair or clip and shave the vein and wash with creosote. Have the assistant near the base of the neck, the needle or an aspirator at the point forward and withdraws the vein the needle. Catch the blood in a mouth bottle. When the blood is let an assistant take the blood continuously with the quantity of blood drawn the number of cattle inoculated after drawing the blood with blood and inoculate injecting one cubic centimeter of blood animal. The side of the animal is a convenient place for

7. The dose of blood for an animal will take a

2. Inoculate any time from the last of November to the last of March, and it is always best to inoculate the cattle in the South near the place where they shall live.

3. For the infected blood secure a two year old heifer, steer or bull that has had tick fever within a year, or that has had a gross infestation of cattle ticks during the second summer of its life.

4. Secure a sterilized hypodermic syringe (capacity 2 to 3 drams) having two or more strong and sharp sterilized hypodermic needles, a pair of scissors and a sharp scalpel knife, three or four small sterilized, one ounce, breakers or wide mouth bottles, containing a sterile glass rod or small sterile spoon; some absorbant cotton, and some 5 per cent. creolin or other good antiseptic.

5. Every animal to be inoculated should be tied or haltered in a narrow stall before the blood is drawn.

6. Cast the two year old from which the blood is to be drawn or secure it in a standing position. Clip the hair or clip and shave the hair over the jugular furrow or vein and wash with creolin solution and absorbant cotton. Have the assistant to press on the jugular vein near the base of the neck. Press the large hypodermic needle or an aspirating needle into the jugular inclining the point forward and inward. When the needle penetrates the vein the blood will flow freely through the needle. Catch the blood in the sterile beaker or wide mouth bottle. When the beaker or bottle is nearly full, let an assistant take it and stir the blood vigorously and continuously with the sterile glass rod or spoon. The quantity of blood drawn may be regulated according to the number of cattle to be inoculated. As soon as possible after drawing the blood, fill the hypodermic syringe with blood and inoculate the cattle as rapidly as possible, injecting one cubic centimeter under the skin of each animal. The side of the neck and over the shoulder are convenient places for the injection.

7. The dose of blood varies with the age. A young animal will take a relatively larger dose than an old one.

after the inoculation. ]  
die. But good care ma

In preparing for win  
of rye, barley, winter  
winter pastures. Nothi  
inoculation fever bette  
supplemented with plen  
grain or concentrated fo  
a little cotton seed. D  
inoculation, see that th  
infested with ticks. A  
of pure water, and salt  
Shade and running wa  
hot cattle can wade and  
a large number of inoc  
come stunted, and are p

time that some cases  
over.

on always sow plenty  
vinter oats for green  
ry cattle through the  
ity of green pasture,  
ay or silage and some  
n, oats and shorts and  
summer following the  
never becomes grossly  
re, with an abundance  
nt reach are essentials.  
ge pools into which the  
l help. Remember that  
tick infested cattle be-  
ers for one or two years.





TABLE II. *Continued*

KIND OF CATTLE	No.	Sex	Where Bred	Age	Immune	Non Immune	Times Inoculated	Deaths by Inoculation	Deaths 1st Summer	State	County	Ticks Many	Ticks Few
Angus	1	Heifer	Ill.	33 mos.	yes	yes	1			Ala.	Lowndes	yes	
"	1	Bull	Ky.	9 mos.	"	"	1			"	"	"	"
"	4	"	Ky.	8-12	"	"	1			"	Wilcox	"	Boykin, Akerville, Ala.
"	5	Heifers	Ky.	8-12	"	"	1			"	"	"	"
ShortHorn	34	"	Tenn.	8-18 mos	"	"	1			"	Dallas	"	J. E. Dunaway 1903-'04
"	1	Bull	"	8 mos.	"	"	1			"	"	"	"
"	15	"	Mo.	12 to 15	"	"	2		5	Tex.	"	"	Amer. Short Horn Breeders Ass. 1904-05
"	1	"	Iowa	15 mos.	"	"	2		1	Ala.	Chambers	"	A. S. B. A. Slaughter, Lafayette
"	2	Heifer	Mo.	12 to 15	"	"	2		1	"	"	"	A. S. B. A.
"	1	Bull	Mo.	12 mos.	"	"	2		1	"	Lee	"	Edwards, Opelika, Ala.
"	2	H.	Mo.	10 mos.	"	"	2			"	"	"	"
"	1	Bull	Mo.	12 mos.	"	"	2			"	Dallas	"	"
"	1	"	Mc.	14 mos.	"	"	2			"	Perry	"	"
"	1	Heifer	Mo.	12 mos.	"	"	2			"	"	"	"
"	1	Bull	Kan.	14 mos.	"	"	2			"	Lee	"	"
"	11	Heifer	Mo.	7 to 12	"	"	2			Miss.	Washington	"	G. C. Floyd, Opelika "
"	5	"	"	8 to 12	"	"	2		1	Ala.	"	"	A. T. Stoval, Okalona, Miss
"	2	Bulls	"	12 mos.	"	"	2			"	Sumter	"	H. K. Milner
"	1	"	"	12 mos.	"	"	2			"	"	"	"
"	1	Heifer	"	12 mos.	"	"	2			"	"	"	W. G. Little
"	2	"	"	12 mos.	"	"	2			"	"	"	R. Seale
"	4	"	Kan.	10 mos.	"	"	2			"	Clay	"	"
"	1	Bull	Mo.	10 mos.	"	"	2			"	"	"	J. C. Street, Opelika
"	1	"	"	10 mos.	"	"	2			"	Lee	"	"
"	1	"	"	10 mos.	"	"	2			"	"	"	T. Wimberly



TABLE II. Continued

KIND OF CATTLE	No.	Sex	Where Bred	Age	Immune	Non Immune	Times Inoculated	Deaths by Inoculation	Deaths During 1st Summer	State	County	Ticks Many	Ticks Few
Short Horn	1	"	Mo.	12 mos.	..	yes	2	..	..	Ala.	Lee	yes	yes A. S. B. A. Ala. Expt. Station
"	1	"	Ky.	15 mos.	..	..	1	..	..	..	Dallas	..	" " C. Kirkpatrick Cahaba, '05
"	9	Heifers	Ky.	8 to 10	..	..	1	..	6	..	"	..	" " " " " '04
"	16	"	Ky.	6 to 10	..	..	1	..	..	..	"	..	" " " " " '05
"	2	Heifers	Ky.	4 to 7	..	..	1	..	1	..	Marengo	..	R. Seale Livingston, Ala.
"	1	Bull	..	6 mos.	..	..	1	..	..	..	Sumter	..	Edmonds, Coatopa, Ala.
"	1	Bull	..	4 mos.	..	..	1	..	..	..	Butler	..	J. L. Horn, Coatopa, Ala.
"	1	Bull	..	10 mos.	..	..	1	..	..	..	Elmore	..	J. T. Watt, Greenville, Ala.
"	1	"	Mass	8 mos.	..	..	1	..	..	..	Marengo	..	W. E. Benson, Kowaliga, Ala.
"	2	"	..	4 to 7	..	..	1	..	1	..	Macon	..	R. L. Seale, Livingston, Ala.
"	9	Cows	Pa.	1 to 16y	..	..	1	2	..	..	Talladega	..	Tuskegee Normal School 1903-1904.
"	3	Bulls	Pa.	2 to 3	..	..	1	..	..	..	Macon	..	" " " " " "
"	5	Bulls	Ky.	8 to 12	..	..	1	..	..	..	Wilcox	..	Giltner Thornton Cattle Co.
"	6	Bulls	Ky.	8 to 12	..	..	1	..	..	..	Wilcox	..	B. L. Bykin, Ackerville, Ala.
"	37	Heifers	Ky.	8 to 12	..	..	1	..	2	..	Macon	..	Tuskegee Normal School 1903-1904
Gurnseys	11	Cows	N.Y.	1 to 12	..	..	1	2	..	..	Macon	..	" " " " " "
Holstein	7	Cows	Pa.	2 to 9	..	..	1	2	..	..	Macon	..	W. K. Pickens Livingston.
"	1	Heifer	N.Y.	8 mos.	..	..	1	2	..	..	Sumter	..	Tuskegee Normal School 1903-1904.
Jerseys	9	Cows	Pa.	1 to 12y	..	..	1	2	..	..	Macon	..	1903-1904
"	3	Cows	Ky.	4 to 12	..	..	1	7	..	..	Lee	..	Tuskegee Normal School
Grades	70	Cows	Pa.	1 to 16	..	..	1-2	1	2	..	Macon	..	
"	1	"	Ky.	7 yrs.	..	..	1	..	..	..		..	
"	1	"	Ky.	6 yrs.	..	..	1	..	..	..		..	
"	1	"	Ky.	4 yrs.	..	..	1	..	..	..		..	
"	1	"	Ky.	15 yrs.	..	..	1	..	..	..		..	
Total	448								1				No. inoculated previous to the 448
"	45							21	48				Total No. up to Jan. 1 1906.
Total	493							21	52				

Table II gives a record of all blood inoculations up to January 1, 1906:

The percent of deaths from inoculation is_ _ _ _ _	4.26
The per cent. of deaths the first summer after inoculation . . . . .	10.54
The total per cent. of deaths. . . . .	14.80

One hundred or more of these cattle were too old and not a few were either too fat or too poor to withstand the inoculation. Out of 106 inoculated at Tuskegee, 15 died of inoculation fever and only one died during the first summer. The majority of the 106 were over two years old. While the average per cent. of deaths is high, taking the cattle at any age as they come and in all conditions; with a great variety of kinds of care and treatment, the losses are not as great as one should expect were like conditions presented.

# Selected Temperature Records Following Blood Inoculations for Immunity.

TABLE III

DATE	46		100		58		82		37		86		
1904-1905	a m	p m	a m	p m	a m	p m	a m	p m	a m	p m	a m	p m	
<b>December</b>	1	103.8	106.1	102	103.1	101.3	102.3	104	105	103.1	104	101.2	103.3
	2	103.2	103.8	104	104	104.2	104.1	104	104.4	103.4	103.8	104.3	104
	3	104.5	103.9	104	103.9	104.2	104.5	104	104.1	102.2	105.4	103.5	105.4
	4	102.9	102.5	103.8	103.1	104	103.4	104.9	103.2	105.4	103.5	104.2	104
	5	103.8	103.5	106	103	103.2	104.5	104.5	104.2	104.5	105	103.9	104.5
	6	101.5	103.8	103.1	102.8	101.4	102.5	105.1	104.5	103.4	104.8	102.9	104.2
	7	101.8	102.9	101.8	104.5	103.4	103.4	104.9	105	103.1	104.5	105	106.1
	8	105.4	104	102.8	102.2	105	104.4	103.5	104.8	104.8	105.5	105	104.2
	9	104	106.9	102	102.2	104.5	104.1	104	105.1	105.1	106	105.9	105.9
	10	105.9	104.1	103.4	102.5	105.1	104.8	104.1	101.8	105.5	106	104.5	105
	11	101.5	106	101.5	102.9	104.8	104.1	103.5	103.1	102	103	104.5	102.9
	12	103.1	103.8	102.8	102.2	102.5	101	103.5	103.1	103.5	102.9	104.8	103.8
	13	101.9	104	102	103.8	101	102	101	103	101.5	101.9	103	103.8
	14	103.9	101.8	101.2	102.4	101	101.3	103.1	103.1	102.9	102.9	101.1	102.9
	15	102	102.3	101.9	102.3	101	101.3	103.8	103.6	103.9	103	101.9	102.8
	16	101	102.4	102.1	101.9	101.9	102	103	104	104	103.1	101.5	101.5
	17	102	102.4	102	102.6	102	102.5	104	102.8	103.2	102.6	103.9	103.3
	18	101	102.5	102.5	103	101.8	102	104	105.4	103.1	102.9	102.1	104.5
	19	101	102.9	101.8	102.9	103	102.9	102	103	102.1	103.2	102.9	103.8
	20	101	103	102.4	103.8	102.1	103.2	102.9	104.5	101.9	102.8	103.9	103
	21	101.5	104	102	103.5	103	104.9	102.4	103	102	103.2	102.9	104.5
	22	101.8	101.9	100.9	102.9	104.5	106.9	103.9	103.5	102.8	103.4	102	102.9
	23	102	103.8	101.8	103.8	106.5	106.9	103	103.8	103.5	106	102	103.5
	24	102.9	102.4	102.8	101.8	105	102.6	103.8	101.5	106	102.4	102.8	100.3
	25	103.4	104	103.4	102.4	102	103.2	103.5	104.6	102.6	102.8	103	103
	26	103.8	104.2	103.4	102.3	102	104.6	104	106.1	103.2	102.5	103.2	103.3
	27	102.5	99	102.6	101	102.8	100.0	04.6	103	103.5	99.6	104	100.3
	28	101.3	101.9	103.6	103.3	101	103.3	102.2	101.8	101.8	104.5	101.3	102
	29	101.7	102	102.8	103.5	101.5	102.9	101.3	102.9	101.7	102.4	102.2	102.4
	30	101.2	102.8	104	105.4	102	103.2	102.9	103.5	101	101.9	105.5	104.4
	31	102	102.9	102.5	104.5	103.5	103.8	104	104	101	103.2	100.9	100.8
<b>January</b>	1	101.4	102.9	102.2	103.9	103.9	105.2	104	105	101.9	102.6	103	104.4
	2	103	102.8	102	105.5	103.9	103.9	105	105	102.9	103.2	102	100
	3	102	103	102.9	105.2	103.9	104.2	103.9	105.5	102.8	104.2	102.9	103.5
	4	102.5	103.9	100.9	104.8	101.9	102.5	105	106.9	102.9	103.8	102	104
	5	103.5	104	102	104.5	102	103.5	105.8	103.6	103.5	104.9	103	103.6
	6	103.5	103.9	104.5	104.5	103.9	103.6	105.4	104.8	104.5	103.5	103.5	104.5
	7	102.5	103.8	103.4	105.2	102.9	104.2	104.2	105.9	103.9	104.5	105.5	104
	8	104	104.5	104	104.9	103.8	104.9	103.5	107	105	105	102.5	104
	9	103.9	103.8	103.4	103.9	104	105	103.2	104	104.4	102.5	104.4	104.5
	10	104	103.2	103.5	104.8	103	104.8	103.5	103.8	104	105.8	105	105.2
	11	103	102.2	102.5	104	105	102.9	104.4	105.5	104	106	104	104.5
	12	103.2	102	104	103	104.9	103	105	103.5	105.2	105	105.5	104.2
	13	103	102.5	104.2	102.5	103.2	102.8	104.5	102.5	105	104.5	105	103.8
	14	102.5	104.5	102.4	102.5	102.9	102	102	103.5	103.5	101.2	104.4	103.8
	15	101.9	104	101.8	102.5	101.5	102.2	102.8	101.5	104	104	102.8	105
	16	104	104.5	101.5	103.5	101	102.5	101.8	102.8	103.2	104.5	102.4	104.8
	17	102.4	103	100.9	104	100.5	102.5	102.4	103.5	103	104	101.5	103.2
	18	102	103.2	100.5	102	101	102	106	104	103.5	104.4	101.2	106
	19	102.5	103	101.9	101.9	102.5	104.5	104.5	103	103.5	103	102.5	106
	20	102.9	102	101	101.5	104.5	103.5	103.9	102	103	103	103.5	103
	21	101.4	102.5	101.5	101.5	103	104	102.9	104.5	102.5	102	101	103.2
	22	101.5	102.5	102	101.5	102.5	101.5	103.5	102.5	102.5	104	101	103.2
	23	101.9	101	101.5	100.5	100.4	102.9	101.9	101.5	102	102	102.4	102
	24	103.4	102.5	100.5	101.9	101.5	101.8	103	103	101	102.8	101.9	103
	25	100.9	101	101	102	100.5	101.2	102.5	101.5	102	102.5	101.9	101.9
	26	101.5	102.5	102.5	101.9	100.5	102.5	102.4	101.9	101.5	101.5	101.9	101.9
	27	102.2	102.5	103.2	102	101.9	101.2	102.5	102.9	101	103.2	102.5	102.5
	28	100.4	103	101	102	101.4	101.8	102.9	102.5	102	100.5	102	103
	29	101	102.8	100.9	101.2	102	101.2	101.9	102	101.5	102.9	101.8	101.4
	30	102	102.8	102.8	101.5	102	102.4	103	102	101.5	100.5	103.2	101.5
	31	101	102.9	102.5	102	101.5	102.5	101.5	103	102.5	101	103.5	104

TABLE III. Continued

DATE	46		109		58		32		37		86	
1904-1905	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
February	1 101	101.5	101.5	101.5	102.2	101.9	101.9	102.5	101.9	101.5	102	102.9
	2 101	101.5	101.2	102.5	101.5	102	104.5	102	102	102	102	101
	3 102.5	102.5	102.5	102.9	101	100.9	101.9	102	102.9	102.5	102	102.9
	4 100.9	100.5	101	102	101	101.5	102	102.2	102	100.9	101	102.2
	5 102	102.5	101	102.9	101.2	102.9	103	102.5	102	102.5	100.5	101.5
	6 101.5	102	102.9	101.5	101.5	101.9	103.1	102	103.5	102	102	100.9
	7 100.5	101	101	102	101	102.9	101.5	101.5	101.9	102	102	100.9
	8 101.5	101.5	101.5	101.5	102.5	103.2	102.2	102	102	101.5	100.5	102.5
	9 101.5	102	102.4	102.2	102	102	102.8	102.5	101.9	103.5	102.4	103
	10 101.5	102	101	103.2	101.8	102.5	102	102.5	101	103	104.5	103.9
	11 103	102	102	102.2	102	101.5	102	102.5	103	101.5	100.9	102
	12 101	101.4	102.5	102	100.5	102.5	103.6	102.3	101.8	101.9	101.4	101.6
	13 102	100	101	101	101.5	102.4	102.8	101.2	102.5	100.5	102	100
	14 101.5	102.3	101	102.2	102	103.5	101.5	102.9	101.6	102.5	100.2	102.5
	15 101.4	101.9	101	102	100.8	102.5	101.4	101.5	101.6	102.5	101.5	102.5
	16 100.2	102.5	100.5	101.5	101	102.5	101.8	102	100.3	101.5	101.8	102.5
	17 101.9	102.5	101.5	103	102	102.5	101.5	102.6	101.8	102.8	101.5	102.6
	18 102.5	102.5	100.6	102.8	104.5	104.5	101.9	101	101.5	102.5	101.5	102.9
	19 102	102.5	102	103.2	105	104.5	101.5	102	102	100.5	100.9	101.5
	20 102	103	103	102	102.9	104.3	101.5	102.9	101.2	102.2	102	101.8
	21 102.5	103	102	102	103.2	105	102	101.9	100.2	102	101.5	102
	22 101.5	101.6	102	103	102.6	101.2	102	103.5	101.9	103.8	102	103.2
	23 101.5	102	102.5	102.5	102.9	103	102	103.5	102.9	103.2	103.5	102.8
	24 100	102.5	102.5	102.5	100.5	102.5	101.5	102.9	102.9	103	101.9	101
	25 102.5	103	102.9	103	101.5	102.5	102.9	103	103	103	102.9	103.5
	26 101	101.9	102	104	103	102.5	102.5	103.5	102.5	104	102.5	101.5
	27 102	103.4	101.5	104	101.4	103	102.5	103.5	102.5	103.5	101	103
	28 102.8	102.8	103	103.4	103.8	103.5	102.5	103.5	102.5	103.5	102	102.9
	1 103	103.8	102	103	102.9	103	102.2	103.5	103	104	102	102.5
	2 104	101	103.5	104	102.5	103.4	102.5	105	104.5	104.2	102.5	103
	3 100	101.5	102	103.5	102	103.5	102	104	103.5	105	100	102.2
	4 101.5	102.9	103	104	101.5	102.9	103	104.2	102	104	101.9	103
	5 .....	.....	104	103.5	102	103.5	103.5	105	103.5	104.5	101.5	104.5
	6 .....	.....	103	103.9	104	104.5	104.5	104	104.5	105.2	103.5	103.9
	7 .....	.....	103.5	103.5	101.5	103	103.2	104.5	103.5	104.8	101.9	102.6
	8 .....	.....	102	103.5	104.2	104	101	102	104.2	105	103	103.5
	9 .....	.....	101.5	102.3	103	104	102.5	103.4	102	103.5	103	103
	10 .....	.....	103	104.5	102	102.5	100.9	102.6	103	103.5	103.5	103.1
	11 .....	.....	102.5	101.3	100.9	101.5	102	101.9	103.5	102.6	101	101.5
	12 .....	.....	102.9	103	101.9	102.5	101.5	101.9	102.5	103	101.9	103
	13 .....	.....	102.5	103.6	102	102.5	102	103	102.9	102.9	102	101.5
	14 .....	.....	102.2	103.5	101.5	103.5	102	103.6	102.5	104	101.5	102.2
	15 .....	.....	102.9	104.4	101.2	103.2	103	103.8	102	104.5	101.2	103.5
	16 .....	.....	103	105	103	104.2	105	104.5	102.2	104.6	103.2	102
	17 .....	.....	103	104.2	101.2	103.9	103	103.6	103.5	104.9	103	103.5
	18 .....	.....	102.5	104	102	103.5	101	103.9	102.5	103.9	102	103.5
	19 .....	.....	102	103.2	102.5	104	103	103.5	103	104.9	102	103.9
	20 .....	.....	102	103.5	101.9	104	102	104	102	104.2	102	103.2
	21 .....	.....	102	103	102	103.7	102.9	103	102.5	104.5	102.3	103.5
	22 .....	.....	103	102.5	103	104	102.8	104	103	104.9	102.5	103.5
	23 .....	.....	102	103.9	104.5	103	102.5	103.9	104	104.5	102.5	103
	24 .....	.....	102	102	101.9	104	102.5	104	103.5	105	102.5	103.9
	25 .....	.....	102	102.5	103	104	104.5	104	104	104	102.5	102.9
	26 .....	.....	101.9	102.9	101.9	104.5	102	103.9	103	104	102	103.5
	27 .....	.....	101.5	102.9	101.2	104.5	102.5	103.9	101.5	105	102	104
	28 .....	.....	101	102.5	102.9	105.5	102.9	103	102.5	105	103.5	104.5
	29 .....	.....	.....	.....	.....	101.5	102.5	.....	104	104.4	101.5	102.2
	30 .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	31 .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

**Table of Selected Temperature Records of Inoculated Cattle that Died of Inoculation Fever.**

TABLE IV.

DATE	588		649		641		650		648		609	
1907	a	m	a	m	a	m	a	m	a	m	a	m
January	16	100.8	101.2	101	101.2	104	101.4	101	106.3	101	101.2	101.6
	17	101.2	102	101	101	101	102	102.4	102	101	101	101.6
	18	104.4	100.6	100.6	101.6	101	101.6	102.4	100.2	101.4	101.6	101
	19	101.2	102	101.8	101	100.8	101.4	102.2	101	101.3	101	101.4
	20	101.6	103	101	101	101	102.4	100.4	102	102	101.4	100.4
	21	101.6	104	101.8	104	102.4	102.2	102.2	104.2	100.4	101	101.4
	22	105	104.8	106	102.2	104.6	105.6	101.8	101	101	101.6	101.8
	23	101.4	104	102.6	105.8	104.4	102.8	100.4	102.2	101.8	102.2	101.4
	24	100	101	105.6	106	104	104.8	101.4	102	103.6	104	101
	25	102.2	102	104	100	102	105	101.6	101.2	102	102.4	101
	26	100.4	100.6	99.8	101.8	102	102	101.2	98.4	101.2	103.6	101.8
	27	101.6	104	101.2	101	101.6	101.4	102	102.4	101	104	102.2
	28	101.6	101	102.2	102.8	101	101.4	100	101.8	103	103.4	101.8
	29	101.4	100.4	103.4	101.4	102.5	102.6	101.6	99.5	104	106	101.6
	30	102	103.8	102	103.4	101	102.4	102	102	102	103.2	101.6
	31	101.4	102.4	103.4	104	102.2	102	102	104.6	103	101	102.4
February	1	102	103	102	103	103	102.2	100.6	102	103	102	102.4
	2	101.4	103.2	102	101.2	103	104.6	101.6	101.6	101	102.2	102
	3	103.8	103.2	102	103	103	101.9	101.2	101.2	101	102.2	102
	4	100.6	103	102.2	103	103	108	101	104	101.7	102	102.2
	5	100	103.2	101.6	102.2	103	102.8	101.2	103.2	101	103	101
	6	101	103	103	103	102.8	103	102	102.8	101.2	103.2	102
	7	102.2	102.8	102	102.2	103	103.4	103	103	102.1	102.8	101.8
	8	102.6	104.2	102.4	102	102.2	105.6	101.6	102	102	104	101.8
	9	103.4	103	103	102	104.3	104.9	101.6	102.3	103	103.9	104
	10	102.8	102.8	101.2	102.3	103	105.3	102	102.4	101.8	102.5	103
	11	101.4	100	102.2	99.4	104	106.4	101	100.2	100.8	100	104.4
	12	104	104.6	101.4	102.4	104.6	104.2	101.8	102	101	102.7	103.8
	13	104.8	104.8	102	101.4	103.2	103.6	101.8	100.8	101	104	99.2
	14	104.6	103.2	101	101.6	104	105.6	101.8	100.2	104.4	103.8	103
	15	99	101.8	101.4	102.8	102.8	102.6	102.2	102	100.2	100.8	98.5
	16	99	.....	101.6	102	102	103.4	101.7	100	101.4	101.2	100
	17	.....	.....	102.6	103	104.2	105.6	102	102	101.4	103.6	100
	18	.....	.....	103.8	104	101.6	102.3	102	101.6	102.6	102	.....
	19	.....	.....	102.6	103.4	104.2	104	103.8	99.1	103	104	.....
	20	.....	.....	102.6	103.4	103.5	104	101.8	.....	102.2	103	.....
	21	.....	.....	102	102.6	104	103.2	.....	.....	103.2	102.2	.....
	22	.....	.....	103	105.4	104	103.8	.....	.....	103.6	104.5	.....
	23	.....	.....	98	101.8	104	105.6	.....	.....	103.4	102.3	.....
	24	.....	.....	102	106	102	105.6	.....	.....	101	101	.....
	25	.....	.....	102	105.4	98.5	104.6	.....	.....	100.2	100.6	.....
	26	.....	.....	99	102	101	105	.....	.....	.....	.....	.....
	27	.....	.....	100.2	104	102	103.6	.....	.....	.....	.....	.....
	28	.....	.....	101	102.4	100.8	101.3	.....	.....	.....	.....	.....
	29	.....	.....	101	.....	100	102	.....	.....	.....	.....	.....
March	1	.....	.....	.....	.....	100	101.4	.....	.....	.....	.....	.....
	2	.....	.....	.....	.....	99.4	101	.....	.....	.....	.....	.....
	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	4	.....	.....	.....	.....	98	99	.....	.....	.....	.....	.....
	5	.....	.....	.....	.....	98.5	98	.....	.....	.....	.....	.....
	6	.....	.....	.....	.....	98.8	.....	.....	.....	.....	.....	.....
	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV. *Selected Records of 15 Deaths from Inoculation*

Number of the Animal	Days after 1st Inoculation Died	Days after 2nd Inoculation Died	Highest Temperature	Lowest Temperature	Age, Breed, Condition of Animals, Etc.
691	13		107.4	97.8	Grade Jersey
611		22	105.6	99.8	
607	11		107.2	100.6	
649	46		105.8	98.	
580	17		106.8	96.	
655	18		107.2	99.8	
650	37		104.6	98.4	Very fat Gurnsey 12 yrs. old
648	41		105	100.	Very old cow
609	35		106.2	98.5	Jersey cow, 9 yrs. old
646	13		106.4	100.	
623	18		106.8	100.4	Holstein cow, 8 yrs. old
658	13		107.2	103.	Short Horn cow
654		9	107.	100.	Short Horn cow, 4 yrs. old
538	33		104.8	99.	Grade Holstein cow, 7 yrs. old
644	52		105.6	98.	Grade Gurnsey cow, 8 yrs. old

This table shows that a small number die after the second inoculation and that the temperature falls to sub-normal just before death.

The following descriptions of eight kinds of ticks were compiled by Mohler from Salmon and Stiles' work on "The Cattle Tick" and these and Figs. 1, 2, 3 and 4 are taken from Farmers' Bulletin No. 258 of the Bureau of Animal Industry, Department of Agriculture, Washington, D. C.

**TEXAS FEVER, OR CATTLE, TICK (*Boophilus annulatus*.)**

—Figure 3, No. 1a, shows the natural size of an adult female Texas-fever tick, whose characteristic markings are better brought out in No. 1, magnified four times.<sup>a</sup> This tick may be readily distinguished from the other seven ticks by the small size and the color of the head and shield, the so-called head parts, whose lateral borders are straighter and more parallel, as shown in No. 1b. These head parts are short and relatively broad and dark reddish brown or chestnut brown in color, appearing as a convex plate on the median line at the fore end of the

<sup>a</sup> In figures 3 and 4 various ticks that infest cattle are shown as follows: The natural sized nature female tick, this tick magnified four times, and the head and shield of the same enlarged ten to fifteen times.

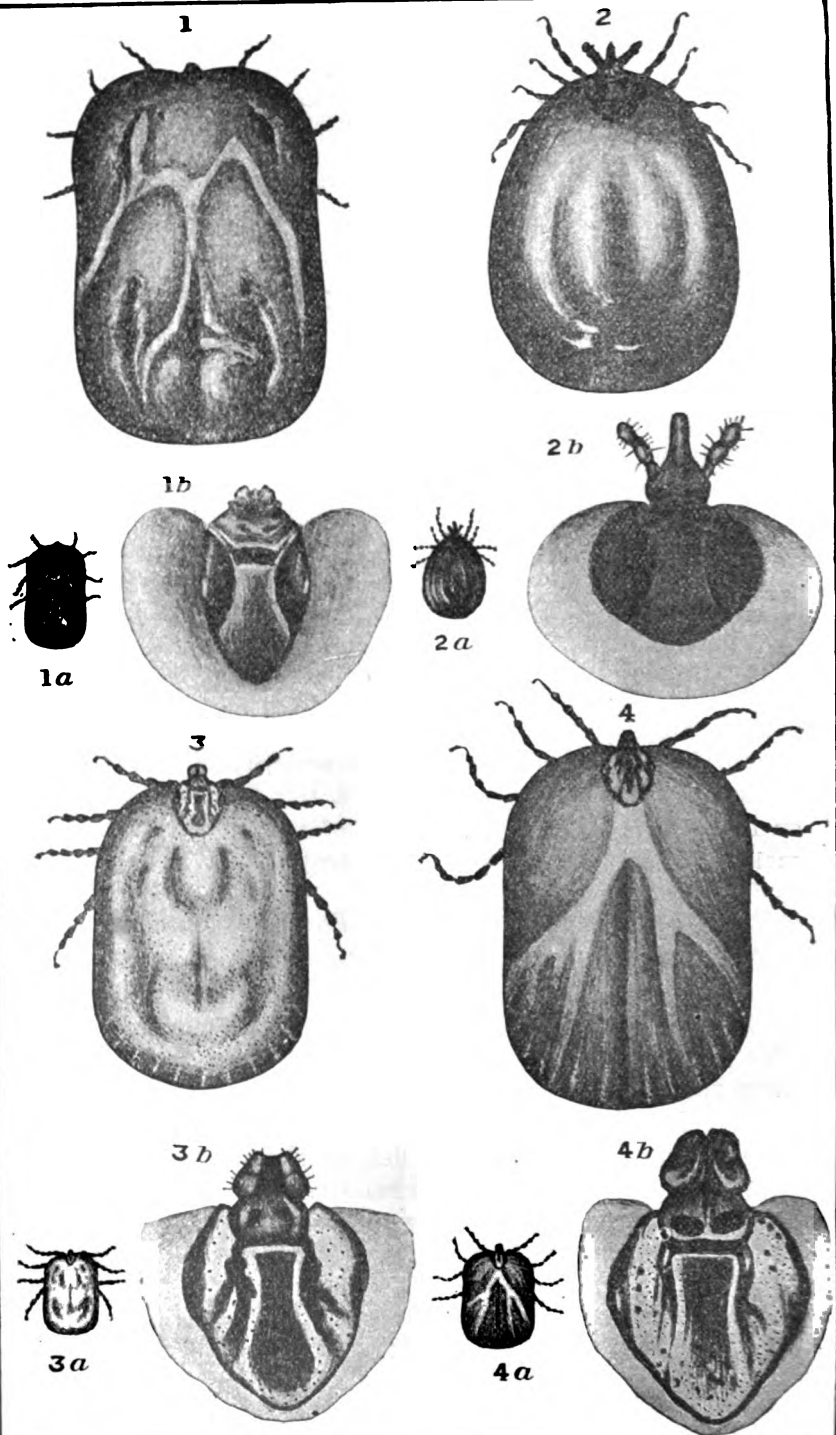


FIG. 8.—Various ticks that infect cattle

tick. The body is oblong oval in shape and may reach one-half inch in length. The color varies from a dull yellow to an olive brown; often it is mottled with irregular areas of yellow and brown or streaked with wavy lines of these colors. Two grooves or indentations are seen running from the front to the rear on the skin of the back, which become almost, if not entirely effaced at about the middle of the body. Another groove is seen between these two grooves in the posterior half of the body. These grooves are caused by the contraction of the muscles of the body and therefore vary considerably, entirely disappearing when the tick is full of blood. They are very distinct when the ticks have been removed from cattle several days. The four pairs of legs are brown, moderately long, and very slender. This tick is found principally on cattle, less frequently on horses, mules, and asses, and in one case it was found on a deer. The Federal quarantine line indicates the northern boundary of the section of the United States infested with fever ticks.

**CASTOR-BEAN TICK (*Ixodes ricinus*).**—The body of this tick (fig. 3, Nos. 2 and 2a) resembles in shape that of an eggplant, and it takes its name from its similarity to the bean of the castor-oil plant. It is lead colored, with a variegated mixture of yellowish red, brown, or gray. The body contains two anterior grooves that slightly diverge from each other, and three posterior grooves, the middle one of which is straight, while the other two are curved outward. The mature female is from three-eighths to seven-sixteenths inch long and has four pairs of dark-brown thin legs. The head and adjacent shield are a shiny dark brown or a chestnut brown, the latter portion being five-sided, like a pentagon (No. 2b), with laterai borders prominent and rear angle rounded. Two stout and well-developed feelers (palpi) may be seen extending outward on each side of the head. This tick has been collected from sheep, cattle, goats, horses, deer, dogs, cats, foxes, rabbits, birds, man, and a few other animals.



It was one of the first ticks studied, and has a very wide distribution in the United States.

**NET TICK** (*Dermacentor reticulatus*).—The body of the adult female tick is oblong oval, five-eighths inch long, and of a deep brown or slate color (fig. 3, Nos. 3 and 3a). It has four pairs of brown legs of moderate length. The skin of the back and head is covered with fine points, or punctations, which almost disappear at this stage. Besides the grooves that are located like those in the cattle tick, there is a marginal groove extending around the body just inside the border. There are also eleven small indentations (festoons) arranged about the posterior margin of the body. These festoons and grooves become shallow or effaced in the adult stage. The shield portion of the head parts has a silvery white metallic rust extending along the two sides and posterior portion (No. 3b). It may have a rose or greenish tinge. The head is larger than that of the cattle tick. The net tick has been found on man, cattle, horses, sheep, and deer; and in this country it seems to be most common in the West, especially in California, Texas, and New Mexico.

**AMERICAN DOG TICK; ALSO CALLED WOOD TICK** (*Dermacentor electus*).—This tick (fig. 3, Nos. 4 and 4a), resembles the net tick (*Dermacentor reticulatus*) so closely that a hand lens must be used to distinguish between them. However, it can be readily known from the Texas fever tick by the fact that the so-called head parts are longer and broader (No. 4b). Here there is also a yellowish white rust in the posterior portion which extends anteriorly along each side as two bright, iridescent lines separated by a central brownish area. The body is oblong oval in shape and measures as much as three-fifths inch in length. The skin of the back contains grooves like those found in cattle ticks, and, in addition, another groove extending around just inside the margin, together with eleven smaller grooves (festoons) on the posterior border. These lines, so distinct in the young female, become shallow at maturity. This tick has been found on

man, cattle, dogs, horses, rabbits, and panthers, and has been collected in woods and on uncultivated lands in many sections of this country, especially in eastern United States.

**LONE STAR TICK** (*Amblyomma americanum*).—As indicated by Nos. 5 and 5a of figure 4, the body of this tick is oblong oval and of a yellowish gray or brown color. The skin is rough and puckered unless the body is full of blood. The reddish brown area at the front of the tick is composed of the head and head shield. The latter extends backward a short distance to form a triangle, in the apex of which is a white or metallic-yellow spot from which it derives its name "Lone Star" (No. 5b). The mature female may reach one-half inch in length and has four pairs of long thin legs. This tick has been found on cattle, dogs, horses, sheep, goats, hogs, and man, and is very widely distributed in the United States.

**EAR TICK** (*Ornithodoros megnini*).—As will be observed from Nos. 6 and 6a, figure 4, the shape of this tick is similar to that of the body of a violin. It is nearly twice as long as broad, rounded at both ends, narrower behind than in front, and slightly constricted in the middle. In color it varies from gray or brown to violet, and has two grooves behind the head, with a middle one in the posterior portion. On the skin of the back are numerous minute spines, or stiff hairs. The adult females are from one-fourth to three-eighths inch in length, and have four pairs of long stout legs. The anterior portion of the tick is curved downward to form a cover for the very small and short head, which can only be seen from the under side of the tick. The feelers (palpi) and beak, however, stick out from under the front part of the body and can be seen from above (No. 6b). This tick is found in the ears of cattle, horses, mules, asses, and other animals in the South and West.

**CHICKEN TICK** (*Argas miniatus*).—In shape and appearance this tick is like an enlarged bedbug, and is of a uniform reddish brown color, with four pairs of lighter

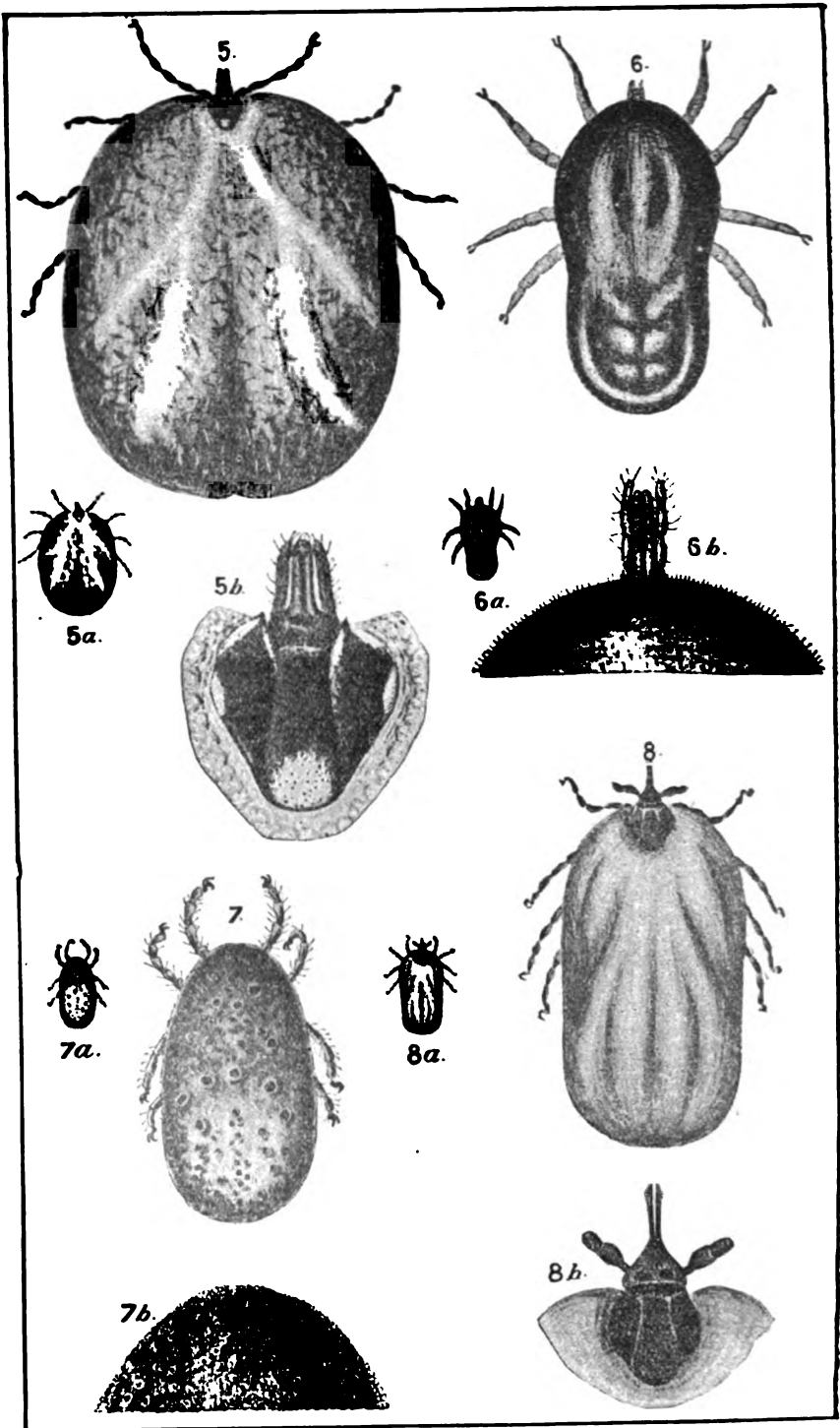


FIG. 4.—Various ticks that infect cattle

colored legs. The skin is wrinkled and contains very short and minute hairs. On the top as well as the bottom of the tick are numerous bright pits or cavities with raised borders (fig. 4, Nos. 7 and 7a). These vary in size, are arranged in rows radiating from the center more or less uniformly, and are usually symmetrical on each side. It is about three-eighths inch in size when mature. The head is so completely covered by the body that it can not be seen from the back (No. 7b). This tick has been observed on cattle once only, but is frequently found on chickens, turkeys, and other birds in the South.

**EUROPEAN DOG TICK (*Ixodes hexagonus*).**—The body of this tick is oval in shape and of an ashy color (fig. 4, Nos. 8 and 8a). The grooves on the back are united in an arch in front and diverge in the posterior portion of the body. The four pairs of legs are longer, thicker, and stronger than those of the cattle tick. The head and shield are brown-red in color and similar in shape to those of the castor-bean tick, but less oval and rather more lozenge-shaped, with more acute lateral angles and narrower posterior angle (No. 8a). The palpi, or feelers, are longer and more prominent than in the cattle tick, but not so long as in the castor-bean tick. This dog tick has been collected from dogs, cattle, sheep, foxes, rabbits, squirrels, gophers, cats, birds, man, and other hosts in eastern United States.

#### LIFE HISTORY AS OBSERVED IN ALABAMA.

The following cattle tick records were made by Mr. W. M. Lewallen, while a student at Auburn, Ala., from August, 1905, to August, 1906. The fall of 1905 was dry, the winter was average with alternate periods of cold and warm weather. The spring of 1906 was early and average in moist and dry spells, and the summer was hot and wet.

Out of 20 ticks that began to lay from August 11 to 19 the number of days between laying and hatching were as follows: 30, 29, 23, 24, 23, 23, 23, 24, 25, 25, 25, 25, 25, 25, 25, 26, 27, 27, 25 days—an average of 25 days.

The ticks were all dead as follows: 35, 35, 35, 35, 35, 35, 35, 36, 35 days, an average of about 35 days and including the progeny of half the ticks. Of the other half after 35 days the progeny of two ticks were all alive and active, and after 35 days the progeny of the remaining ticks were nearly all dead.

In another lot of four ticks that began to lay September 19 to 21, hatching began after 40, 48, 42, and 46 days or an average of about 45 days. After 122 days and 228 days the progeny of two ticks were all dead. After 63 days the progeny of one tick were alive, but inactive.

*Tick Egg-Laying Record for 1905-1906.*

DATES	DAYS	EGGS LAID
From Oct. 31, 1905 to Feb. 12, 1906 .....	104	3016
From Nov. 27, 1905 to Feb. 12, 1906 .....	97	1632
From Jan. 21, 1906 to Mar. 15, 1906 .....	53	1141
From Jan. 22, 1906 to Apr. 6, 1906 .....	74	1487
From Jan. 22, 1906 to Mar. 19, 1906 .....	56	1694
From Jan. 21, 1906 to Apr. 23, 1906 .....	92	3840
From Jan. 21, 1906 to Apr. 19, 1906 .....	88	3101
From Jan. 21, 1906 to Apr. 23, 1906 .....	92	2840
From Feb. 15, 1906 to Apr. 6, 1906 .....	50	1013
From Mar. 3, 1906 to May 3, 1906 .....	61	2981
From Feb. 12, 1906 to Apr. 26, 1906 .....	73	3586
From Feb. 23, 1906 to Apr. 28, 1906 .....	65	2388
From Apr. 5, 1906 to Apr. 28, 1906 .....	23	3687
From Apr. 7, 1906 to Apr. 26, 1906 .....	19	2987
From Apr. 5, 1906 to Apr. 30, 1906 .....	25	3210
From Apr. 5, 1906 to Apr. 27, 1906 .....	22	1858
From Apr. 6, 1906 to May 1, 1906 .....	25	2724
From Apr. 3, 1906 to May 1, 1906 .....	28	3132
From Apr. 6, 1906 to Apr. 8, 1906 .....	2	137
From Apr. 3, 1906 to May 1, 1906 .....	28	3003
From Apr. 15, 1906 to May 5, 1906 .....	20	1446
From Apr. 3, 1906 to May 2, 1906 .....	29	2175
From Apr. 23, 1906 to May 9, 1906 .....	16	3496
From Apr. 23, 1906 to May 18, 1906 .....	25	2862
From Apr. 25, 1906 to May 7, 1906 .....	12	1372
From Apr. 26, 1906 to May 7, 1906 .....	11	345
From Apr. 26, 1906 to May 2, 1906 .....	6	164
From May 21, 1906 to June 14, 1906 .....	24	2687
From May 21, 1906 to June 4, 1906 .....	14	1940
From June 18, 1906 to July 8, 1906 .....	20	4261
From June 18, 1906 to July 4, 1906 .....	14	4191
From July 16, 1906 to Aug. 8, 1906 .....	23	3475
From July 16, 1906 to Aug. 12, 1906 .....	27	3947

*Monthly Average Egg Record for 1905-1906.*

First Egg Laid ...	No Ticks ...	Last Egg Laid	Average No. Days.....	Average No. Eggs.....
From Oct. 31, 1906 .....	2	Feb. 12, 1905 .....	100	2324
From Jan. 21, 1906 .....	6	Apr. 19, 1906 .....	76	2350
From Feb. 12, 1906 .....	4	May 3, 1906 .....	62	2492
From Apr. 3, 1905 .....	10	May 2, 1906 .....	22	2435
From Apr. 23, 1906 .....	5	May 18, 1906 .....	14	1648
From May 21, 1906 .....	2	June 14, 1906 .....	19	2313
From June 18, 1906 .....	2	July 8, 1906 .....	17	4176
From June 16, 1906 .....	2	Aug. 12, 1906 .....	25	3711

*Tick Record on Horned Jersey Calf, Texas Ticks*

- Oct. 15. 1905 Infested with 15 ticks.  
 Oct. 19 or 20. Moulded first time.  
 Oct. 21 or 22. Dark brown color; size of pin head  
 Oct. 28 or 29. Moulded second time, grew slowly up till this time.  
 Ticks were brushed off (?) calf at this time before maturing.

**On Hornless Jersey.**

- Nov. 15. Infested with 15 ticks.  
 Nov. 18. Ticks found on inside of thigh.  
 Nov. 20. Ticks lead white.  
 Nov. 21. Ticks darker, nearly brown.  
 Nov. 24. (1) Tick has reddish thorax, abdomen color of oxide of lead.  
 (2) Other ticks are milk white in color.  
 Nov. 27. (2) Tick has yellowish stripe on back.  
 Nov. 28. (1) Tick has yellowish specks on back.  
 Nov. 30. (2) Tick moulded. (1) Tick has yellowish spots on back.  
 Dec. 1. (2) Tick became dislodged leaving his moult on cow  
 (1) Tick moulded.  
 Dec. 5. (3) Tick found.  
 Dec. 6. (3) Tick dislodged. Ticks cannot be found.

**Jersey Calf Below Barn.**

- Nov. 15. Infested with 15 ticks.  
 Nov. 20. Ticks lead white.  
 Nov. 28. Ticks grew larger.  
 Nov. 30. (1) Tick has yellowish stripe on back.  
 Dec. 1. 1, 2, 3, 4 appear about ready to moult; (5) tick has moulded.  
 Dec. 2. (2) Tick moulded (3) Tick has white speck on belly.  
 Dec. 3. 1, 3, 4 Ticks moulded

- Dec. 6. (4) Tick has tick beneath it (male?) about  $\frac{1}{2}$  its size.  
(5) Tick missing.
- Dec. 9. One female tick has two small male ticks beneath her; when she was lifted they seemed to be attached to her and on separation a little blood was present at the attachment. Female lead color, males brown.
- Dec. 9. Another female like the above with only one male. Males don't increase in size while females grow rapidly.
- Dec. 13. Dropped off of calf.  
Total no of days on calf 28  
One tick moulted in 15 days (2nd moulting). Others in 16 and 17 days.
- Red Spotted Calf**
- Dec. 15. Infected calf with 15 ticks. Auburn ticks.
- Dec. 19. (1) Tick found, lead color.
- Dec. 21. 1. Moulded and changed position.
- Dec. 25. 2. Tick discovered, has white speck on abdomen
- Dec. 31. 1. Tick of white cast, about size of pin head.  
2. Tick in process of moulting. Seems to have loose skin.
- Jan. 1. 06 2. Tick has mark on back. 1. Tick whitish skin on belly.
- Jan. 3. Removed moult from both ticks, about size of tack head, dark brown.
- Jan. 5. 2. Tick disappeared, Removed moult from tick 3. Tick 4. getting ready to moult. Tick 5. much smaller.
- Jan. 6. 3. Tick moulted again. larger than yesterday.
- Jan. 7. 6. Tick has one beneath it when discovered to-day.
- Jan. 8. 6. Tick has no tick beneath it
- Jan. 10. 4, 6&7, have males beneath them; females 6&7 about four times size of males with partial moult on posterior half of body.  
5. Tick moulted.
- Jan. 12. 6&7 detached; 7. grown yesterday; 6. removed to-day.  
5. Tick has yellowish marking on back, males of 6&7 still attached.
- Jan. 13. 5. Tick changed location; 4. Tick removed moult; males of 6&7 have disappeared, leaving bloody seat. Found 2 females on abdomen about grown, removed them. 3. Tick moulted.
- Jan. 14. 4. Tick light brown, male left it, not ready for fertilization as she moulted after males sought her.

3. Tick has 2 males beneath her.  
 Jan. 16. 4. Tick had a male beneath her. Only one male under tick 3.  
 Jan. 18. 3. Tick engorged removed for breeding male left on calf.  
 Jan. 19. Male of tick 3 gone.  
 Jan. 23. 4. Tick engorged removed.  
 Jan. 24. Found two more engorged females, left them to see how long they remain.  
 Jan. 25. Two ticks found yesterday have dropped. Another found but disappeared.  
 Tick 4 engorged in 39 days removed by hand.  
 Tick 3 engorged in 34 days removed by hand.  
 Tick 1 moulted in 6 days.  
 Removed moult from 1&2 in 19 days.  
 Removed moult from 3 in 21 days.  
 Tick 5 moulted in 26 days.  
**Jersey with Horns.**  
 Jan. 15. Infested with 15 ticks.  
 Jan. 16. 1 tick found.  
 Jan. 19. 1 tick again found, white spot on posterior part, probably moulted 18th.  
 Jan. 27. No ticks found from 19 to 27.  
 Jan. 30. Found a tick size of pin head, lead color.  
 Feb. 2. Tick oval shape, has yellow stripes on back.  
 Feb. 4. Tick moulted.  
 Feb. 9. Dark brown color.  
 Feb. 13. Tick mated.  
 Feb. 13. 2 ticks found ready to begin 2nd molting.  
 Feb. 14. 1. tick dislodged.  
 Feb. 15. Male of 1 tick still attached.  
 Feb. 16. Male of 1 tick gone, 2 tick moulted.  
 Feb. 29. 2 tick dislodged.  
 Mar. 8. 2 tick couldn't be found.

Ticks collected on January 15 began to deposit eggs March 12 and continued during a period on an average of 40 days. Ticks collected on April 15 began to deposit eggs April 25 and continued during a period of an average of 17 days. The average length of life of ticks on cattle for late summer and early autumn was 22 days for three tests. Longevity of larvae during the late fall and winter was six months and during the summer and autumn thirteen days. The average length of parasitic period for five ticks during the latter part of summer, autumn, winter and early spring was twenty-nine days, the longer period prevailing in winter.



The following records were made by C. T. Butler, while a student assistant in the Veterinary Department, during 1906 and 1907.

Bottle No.	Date Laid	Date Hatched	Percent Hatched (Approximate)	When dead and Remarks
All	Aug. 20-Sept. 20, '06	Began Sept. 19, '06		One bottle dead Oct. 15; another Oct. 20, due to lack of moisture (?). In the other bottles many ticks dead Mar. 20, 1907. Ticks dead in all but one bottle Mar. 28; in this bottle about half dead. Apr. 3, few ticks alive, but dead Apr. 10, 1907.
1	Sept. 20-Oct. 4, '06	Nov. 19-22, 1906	100	All dead but few Mar. 28; dead Apr. 1, 1907.
2	Sept. 20-Oct. 5, '06	Nov. 19-22, 1906	100	Many dead Mar. 28; all dead May 5, 1907.
3	Sept. 20-Oct. 27, '06	Nov. 19-22, 1906	100	All dead Mar. 28, (lack of moisture) (?)
4	Sept. 20-Oct. 29, '06	Nov. 15-22, 1906	100	All dead but few Mar. 28, '07. All dead Apr. 1, 1907.
5	Sept. 20-Oct. 1, '06	Nov. 19-22, 1906	100	All dead Mar. 28; due to lack of moisture (?).
1	Oct. 22-Nov. 22, '06	Began 3-10, 1907	10 to 20	Few ticks dead Apr. 12, '07
2	Oct. 22-Nov. 58, '06	Began 3-10, 1907	10 to 20	Few ticks dead Apr. 12, '07
3	Oct. 23-Nov. 9, '06	Began 3-5, 1907	5 to 10	4 to 10 ticks living Apr. 28. most of ticks died soon after hatching.
4	Oct. 22-Nov. 12, '06	Began 3-5, 1907	10 to 20	4 to 10 ticks living Apr. 29, dead May 22, most died early.
5	Oct. 22-Nov. 12, '06	Began 3-5, 1907	10 to 20	More than half dead Apr. 29, 1907.
1	Nov. 22-Dec. 18, '06	Began 4-3, 1907	1 to 5	Most of Eggs shriveled; few dead Apr. 29.
2	Nov. 21-Dec. 18, '06	Did not hatch	0	Possibly too much light.
3	Nov. 21-Jan. 16, '07	Began 4-3, 1907	not over 5	Few dead May 23.
4	Nov. 22-Dec. 18, '06	Began 4-3, 1907	5 to 10	Few dead Apr. 29.
5	Nov. 24-Dec. 18, '06	Began 4-3, 1907	10 to 15	Nearly all dead May 23.
1	Jan. 7-Feb. 5, '07	2 hatched Apr. 29	0	Egg shriveled.
1	Jan. 18-Mar. 5, '07		0	Eggs shriveled
2	Jan. 19-Mar. 26, '07		0	Probably due to too much light.
3	Jan. 19-Mar. 2, '07	1 tick but dead		
1	Mar. 2-25, 1907	May 10-23	30 to 50	
2	Mar. 3-26, 1907	May 6-23	70 to 90	
3	Mar. 4-30, 1907	May 10-23	30 to 40	
4	Mar. 5-26, 1907	May 10-23	40 to 60	
5	Mar. 5-25, 1907	May 6-23	80 to 90	
1	Mar. 22-Apr. 1, '07	May 22		
2	Mar. 23-Apr. 26, '07			
	Mar. 27-Apr. 9, '07			

Of the ticks that hatched Nov. 1906, bottle 2 lived until May 1907, others died some time before probably due to lack of moisture.

The probable reason for eggs (laid between Oct. and Mar.) being shriveled is too much light. Direct rays of the sun was sometimes on them, for 2 hours per day.

*Summary of Butler's Tick Records.*

Aug. 20-Sept. 10.	6 ticks laid from 305-3,456 eggs.....	Ave 1,623
	Laying period from 18-22 days.....	Ave. 20 days
Sept. 20-Oct. 5.	5 ticks laid from 1,056-2,243 eggs.....	Ave. 1,520
	Laying period from 8-10 days.....	Ave. 12 days
Oct. 22-Nov. 28.	5 ticks laid from 1,125-2,646 eggs.....	Ave. 1,703
	Laying period from 18-37 days.....	Ave. 25 days
Nov. 21-Jan. 16.	5 ticks laid from 2,235-2,937 eggs.....	Ave. 2,599
	Laying period from 27-56.....	Ave. 33 days
Jan. 7-Feb. 5.	1 tick laid 1,978 eggs .....	1,973
	Laying period, 29 days.....	29 days
Jan. 18-Mar. 5.	3 ticks laid 833-1,721 eggs.....	Ave. 1,192
	Laying period, from 26-46 days.....	Ave. 39 days
Mar. 2-30.	5 ticks laid 1,419-3,413 eggs.....	Ave. 2,414
	Laying period, 23-28 days.....	Ave. 24 days
Mar. 22-Apr. 26.	3 ticks laid from 340-3,745 eggs.....	Ave. 1,371
	Laying period from 9-34 days.....	Ave. 20 days
N. B.—Tick 3	was only half-grown eggs; did not hatch.	
Apr. 25-May 20.	5 ticks laid from 1,143-3,703 eggs.....	Ave. 2,656
	Laying period from 8-25 days.....	Ave. 20 days

*Summary of Non-Parasitic Life of Tick*

Egg-laying period	Average no days	Hatching period	Longevity of Seed Tick
Aug. 20-Sept. 10	20	30 days	A few lived 190 days
Sept. 20-Oct. 5	12	29 days	Few lived for 129 days
Oct. 21-Nov. 28	25	131 days	Few lived for 50 days
Nov. 21-Jan. 16	33	131 days	All dead in 58 days
Jan. 18-Mch. 5	39	no hatching	
Mch. 2-Mch 30	24	64 days	No record
Mch. 22-Apr. 26	20	60 days	No record
Apr. 25-May 20	20		

The winter of 1906 and 1907 was exceptionally warm. The mature laying ticks, eggs and seed ticks were kept in a room with window open and no fire in the room. The seed ticks and eggs were kept in test tubes with moist cotton in the lower part of the tubes.

### WHY ERADICATE THE CATTLE TICK.

The cattle tick lives by drawing the blood from its host, and the host is usually cattle. When undisturbed, the ticks in a pasture get so numerous that they take sufficient blood from the cattle in the pasture, to reduce or retard the growth of the cattle, or check milk or beef production. I have seen cattle go into a tick infested pasture in fairly good condition in the spring and owing to loss of blood by ticks and the tick fever, the cattle came out of the pasture in the fall weighing less and consequently much poorer than when they went into said pasture, and the pasture a good one so far as the grass and water supply were concerned.

Tick fever kills more native cattle in the tick infested areas than all other cattle diseases in the South. Moreover, the cattle tick prevents free trade in the markets of the United States and of the world for the greater part of the year. Consequently, it decreases the market price of southern fed and southern bred cattle from one-fourth to one-half a cent per pound in the cattle markets above the quarantine line.

The losses from death of northern cattle and imported cattle brought into the South have been so great that improvement in the various dairy and beef breeds represented in the South and the introduction of new breeds of cattle have been seriously hindered and checked.

The following tabulated statement will give an approximate idea of the various losses falling upon the tick infested area of the South:

**Number and Value of Farm Animals in Alabama Jan. 1, 1906.**

Animals	No.	Farm Value	Total Value of Each Kind	Total Value of all Animals in Ala. Jan. 1, 1906
<b>Cows</b> .....	253,132	\$ 20 40	\$ 5,163,893	.....
<b>Other cattle</b> .....	496,762	8 32	4,131,822	.....
<b>Horses</b> .....	155,142	93 69	14,535,227	.....
<b>Mules</b> .....	185,839	111 66	20,750,794	.....
<b>Swine</b> .....	1,137,501	4 65	5,289,380	.....
<b>Sheep</b> .....	195,597	2 10	409,776	.....
				<b>\$50,280,892</b>

In the United States Jan. 1, 1906, there were about 67,-000,000 cattle. In the entire quarantined area there were about 15,000,000 cattle. In Alabama at the same time there were 749,894 cattle. Losses coming directly and indirectly from the cattle tick:

1. Decrease from milk production in five million milk cows, one million of which is giving milk all the year. Each cow in milk losing one quart of milk per day and rating that at four cents per quart on the farm.  
1,000,000 x .04 equals \$40,000 per day.  
\$40,000 x 365 gives the loss per year.....\$14,600,000
  2. Loss in the decreased or checked or retarded growth in the other 14,000,000 cattle at \$1 per head..... 14,000,000
  3. Loss of at least \$3 per head on all cattle from the South sold above the quarantine line—700,000 cattle at \$3 each..... 2,100,000
  4. Loss by death from tick fever of 700,000 native cattle each year, valued at \$15 per head ..... 10,500,000
  5. Loss by tick fever of breeding cattle shipped from the North into the South..... 50,000
  6. Cost of the United States and the various quarantined States in maintaining quarantined lines and eradicating the tick..... 200,000
- Total annual loss from the cattle tick in the quarantined area .....\$41,450,000**  
Alabama loses each year about one-twentieth of this total or about \$2,000,000. The total live stock valuation

for Alabama is \$50,280,892. Hence, the cattle ticks in Alabama produce a loss of 4 per cent. each year on the amount or capital invested in live stock.

## METHODS OF ERADICATING CATTLE TICKS.

### I. CLEANING CATTLE.

1. By applying oils to the cattle. This may be employed by using hand cloths or swabs, by spray pumps or by dipping the cattle in a vat or in a dipping tank. The oils that can be used are more or less variable. Beaumont crude petroleum, West Virginia or Kentucky Black oil, cotton seed oil, lard, machine oil, etc., have been employed. Kerosene oil (20 to 25 per cent.) emulsion or kerosene oil (20 to 25 per cent.) in combination with cotton seed oil or with lard have been used. One to two per cent. of sulphur may be added to any of the above oils except Beaumont oil or black oil. The essential things in the use of oils or grease in killing ticks on cattle is to be certain to apply it all over the cattle. If many cattle are to be treated use a spray pump or a dipping tank. (a) If a few cattle are to be greased, a good piece of sacking burlap or cotton bagging may be employed by hand or on a swab stick. Have the animal put into a specially prepared break or chute. Two men (one working on each side of an animal) can grease five to ten cattle in an hour. (b) A spray pump, costing five to fifteen dollars, is very convenient. The bucket spray pump is the cheapest. But the knapsack and the barrel spray pump are very handy. These pumps are the same as horticulturists use in spraying fruit trees. It is well to have a kerosene mechanical mixer attached to pump. With it you can use water or kerosene with the oil. This pump will mix twenty-five per cent. of Beaumont oil with the water and effectually cover the cattle with very little loss of oil. The water possesses no advantage except to spread the oil in thinner layers, to make it go farther and waste less. A quart of Beaumont oil will effectually cover a 700 pound cow with this mechanical mixer spray pump;

while it will take two to four quarts to cover the same cow in putting it on with a hand rag or swab or by immersing her in a dipping vat filled with oil. Two sprayers, one working on each side of the animal, will spray one to two hundred cattle in a day. (c) Oil in the dipping tank or vat is rather expensive. But is sometimes employed in that way—especially by the Federal government and by the large ranch owners in Texas. In order to fill a 2,000 gallon dipping tank it would take a half car load of Beaumont oil. Some have tried it by having about six inches of oil floating on water in the tank. This has not in all cases proven successful. The Beaumont oil may be used in the tank in a 25 per cent. soap emulsion.

Oil has some striking advantages. It destroys ticks, it stays on the hair and skin for several days, it keeps off flies. It prevents skin evaporation and consequently may raise the animal's temperature; to avoid this danger have plenty of shade and water for the cattle for one or two days after oiling them.

2. An arsenical dip has been employed successfully in Cuba, Texas and in one instance in Alabama. Dr. N. S. Mayo, chief veterinarian of Cuba, first used this formula and directions for making it are as follows:

Arsenic trioxid, commercial .....	8 pounds.
Sodium carbonate, crystalized.....	24 pounds.
Yellow soap .....	24 pounds.
Pine tar .....	1 gallon.
Water sufficient to make .....	500 gallons.

Dissolve the arsenic in 20 to 30 gallons of water by boiling 30 to 40 minutes. Add water to make 100 gallons. Dissolve the soda in 20 to 30 gallons of water; dissolve the soap (shaved) in the soda solution; pour the tar into this in a fine stream, stirring at the same time. Mix the two solutions. Add enough water to make 500 gallons.

Dr. John W. Parker, of Texas, made it by leaving out the soap, according to the following formula:

Arsenic .....	8 pounds.
Sodium Carbonate .....	24 pounds.
Tar .....	1 gallon.
Water sufficient to make .....	500 gallons.

This is made in the same way as given in the directions for preparing Dr. Mayo's dip except the soap is omitted. It is best to use free-stone or rain water in making this dip, also exercise great care in having the ingredients accurately weighed and measured.

The cattle should not be held over one minute in the tank. In fact, it is best not to hold the animal in the tank but let it pass at once through and out of the tank to the dripping pen. From the dripping pen let the animal pass into a bare lot or place containing shade and no grass or feed and remain there till dry.

To dispose of the waste or unused part of the dip, care must be taken. Dig a deep pit in some out of the way place where it will not seep into a well. Put the old unused or waste dip into this pit and cover it with plenty of soil. Remember this dip is poisonous. When through dipping, mark the height of the dip in the tank, then if some of the water evaporates before the dip is used again sufficient water may be added to fill the tank up to mark. Or cover the tank when not in use with close fitting lids or cloth to prevent evaporation and filling with rain water. As a rule it is uncertain and often unsafe to use old arsenical dip. Better carefully dispose of the old dip and prepare a new lot just before using it.

This arsenical dip may be used with a spray pump or by a hand swab. Keep your hands greased with lard or vasaline to prevent the arsenic from injuring the skin, or keep your hands out of the arsenical dip.

3. Cresol dips or coal tar dips or insecticides may be employed by hand or in spray pump or in vat. But many of them are so inconstant in strength that one can not always depend upon them for efficient work. I have known

some that were said to kill ticks when used at a strength of 5 per cent. and a trial proved that a 10 per cent. solution was required to do effective work.

4. Picking cattle ticks from cattle may be employed where one or even a dozen dairy cows are stabled twice a day. The big ticks may be hand picked, or rubbed off with stiff brush or curry comb. The ticks that are picked or brushed off should be given to chickens or otherwise destroyed to prevent them from laying eggs and producing more seed ticks. This must be done once every day. Chickens about a cow lot or yard will pick up all the ticks that drop off and pick a large number of ticks directly from the cattle. Begin this picking early in the spring, because every tick killed in the spring means the cutting off of the seed that will multiply into the thousands in the summer and fall. Another good time to begin picking ticks is September 1, and keep it up until January 1 or until ticks disappear, then keep a good keen eye for ticks again the next spring. In fact picking off the big ticks when oiling or applying any tickicide is wise because some half grown and some mature ticks may escape the oil or the other material; fall to the ground and lay eggs.

Feeding sulphur to cattle will not kill the ticks on the cattle or prevent seed ticks from getting on the cattle. The United States Bureau of Animal Industry and other investigators have thoroughly tested the feeding of sulphur to cattle and proven it to be of no value.

#### CLEANING CATTLE OF TICKS WITHOUT THE USE OF TICK-ICIDES BY MORGAN'S FEED LOT METHOD, OR THE PASTURE ROTATION METHOD.

1. The feed lot method was first employed by Morgan. In this the cattle are placed in a feeding pen that has been constructed on tick free ground (plowed ground, cotton or corn or sweet potato ground or any place where cattle have not been penned or left for six months or more, is free of cattle ticks). Keep the ticky cattle in this feed



lot for twenty days—say begin May 1 or any time in spring, summer or fall. At the end of twenty days move the cattle into another cattle-tight feed pen on tick free ground; pen number two should be at least ten feet away from the first pen; keep the cattle all the time in pen number two, for twenty days, and then move them into pen number three of the same kind. As a rule when the cattle move from pen number two into pen number three, the cattle will be entirely free of ticks, no matter how many they had on them in the beginning or when they went into pen number one. This is explained by the life history of the cattle tick. All female ticks when engorged with blood drop off the cattle, hide and soon begin to lay eggs. The tick eggs can not be deposited by the old female tick and then hatch under twenty days. Hence, before any tick eggs hatch or before the appearance of seed ticks in pen number one, the cattle are moved into pen number two. The same is true in pen number two. By the end of forty days in spring, summer or fall all of the female ticks have developed or become mature and have dropped off the cattle. What becomes of the males? They do not count because they can not lay eggs and will not work for their own living. It is always best to keep the cattle in pen number three for ten to twenty days before moving them into tick free areas. This feed lot method of cleaning cattle of ticks is expensive because three pens must be built, the cattle fed and watered in the pens for fifty or sixty days. The expense could be reduced to a minimum by preparing good forage crops like kaffir corn, sorghum, cowpeas, soja beans, and corn thick in the row. Have the crops come so that the cattle can be fed green soiling forage throughout the fifty days. In order to make the water supply cheap build the first pen on the lower part of a small running branch where there are no ticks, build pen number two ten feet or more above it and pen number three ten or more feet above pen number two.

It will be cheaper to apply Beaumont oil thoroughly and

keep the cattle in a tick free pen where they can have good shade and plenty of water and feed for four days, then apply the oil thoroughly again and keep them in shady pen for three or four days more, and they will then be clean or free of cattle ticks, and ready to be turned into a tick free pasture or field.

2. Pastures or fields that are tick free may be used in the same way. Take a hay field of Johnson grass or red clover, or mellilotus, or of crab grass, or of any other forage or grass, divide it into three pastures or move the temporary partition fences every twenty days.

3. Where there are only one to five cattle, they can be staked and cleaned. Always begin at the lower part of the branch and stake the cattle so as to move the stake up the ditch or branch every day. Where the cattle were staked the first twenty to forty days, do not stake there again for three or four months.

#### WHEN SHOULD THE TICK KILLING MATERIALS BE USED.

If an effective or tick killing material is applied at first in the fall (beginning September or October 1st), and it is thoroughly applied once per week until December 1st or until frost appears; and during the winter as often as ticks are found; then keep up the thorough applications once per week from March until May, June or July 1—all the cattle ticks will be killed in the pasture and on the cattle. One thorough application of a good oil will usually kill all the ticks on the cattle, but as soon as the oil is rubbed or washed off the cattle will pick up other seed ticks in the infected pasture or lots. Applying the oil or other material once per week and sometimes once every two weeks will eradicate the ticks in a pasture because as fast as the ticks mature they are killed. Hence, if the mature ticks are all killed for four months in summer and six to eight months in winter all the tick eggs will have perished or hatched into seed ticks and the seed ticks will all have died from starvation or will have been killed on the cattle. This method

admits of beginning in the early spring or early fall,—say from March to December or from September to June. It is most effectual in good pastures where the cattle are confined during the spring, summer and fall in a fixed enclosure. Upon the ranges it is difficult to make it effectual because one or more cattle owners will often fail to regularly and thoroughly apply the tickicide.

## II. CLEANING PASTURES AND TICK INFESTED FIELDS OR RANGES.

1. Keep all cattle, horses and mules off of a given pasture, field or range four months in summer or six to eight months in winter and all the tick eggs will have perished or hatched and all seed ticks will have starved to death. The seed tick lives only on the blood of cattle, horses or mules.

(a) May 1, divide your pasture into two parts with a cattle tight fence so that cattle can not put their heads through between the wires. If possible put a six inch board on the ground or throw up a ridge with a plow on the fence line before the fence is built. Keep the cattle, horses and mules out of the high part (No. 1) and in the lower part (No. 2) from May 1 to October 1. Then move the cattle to a tick-free pen, oil them thoroughly once and in four days oil them again. Now they can be put into pasture number 1 or allowed to run in the corn or cotton field or other tick-free field. Pasture number 2 must be kept closed from October to May or June. The cattle may go into pasture number 1 any time after October 1, providing they are free of ticks. Sometimes the cattle may be turned out of pasture number 2 October 1 or December 1 into the corn field or cotton field and other cultivated fields—(all of which are tick-free in the fall). The time for turning them out will depend upon when the fields are ready and when frosts have appeared. After frosts and cold weather have come the life cycle of ticks is much prolonged and usually by the middle or last of December cattle are free of ticks, and remain clean

all winter providing they are not kept in infected barns, sheds or lots where heating manure hatches out the eggs. Hence, if cattle are turned out of pasture number one October 1 and allowed to run in cultivated fields until March 1 or sometimes until April 1, they may be examined closely for ticks, and if found tick free, can be turned into pasture number two. If not tick free, they should be cleaned by oiling thoroughly before turning them into pasture number two.

(b) September 1 take the cattle, mules and horses out any given pasture, keep them out continuously until the next May 1, and see that the cattle, horses and mules are clean of ticks before returning them to the pasture. This method has been used for several years very successfully by Dr. Butler of North Carolina. When tick free pastures or fields are made, they will remain tick free as long as ticks are not carried into such areas on cattle, horses or mules. In some rare cases, seed ticks or old females may be washed down from higher elevations into a low pasture.

(c) Cultivating land destroys ticks. It is possible that one or two good cultivations of land in summer will make it tick free.

(d) Burning the grass, leaves and weeds in the fall or spring will destroy many ticks, but it will not make a pasture entirely free of ticks. As a rule it should not be advocated because it destroys young timber and burns up vegetable matter.

(e) Heavy, washing rains carry many of the eggs and seed ticks away.

(f) Some insects destroy many of the female ticks and tick eggs.

(g) Dry and hot, sunny places are hard on ticks—in fact seed ticks can not live one month in such places. Shade and a little moisture in hot weather favors the hatching of eggs and the longevity of the seed tick.

## ROTATION OF CROPS AND PASTURES HELP ERADICATE THE TICK.

A few systems of rotation of crops are introduced into this bulletin to suggest ways by which concentrated feed, forage and hay can be produced in sufficient quantities on the farm to enable the farmer to handle his cattle and other live stock during the time of tick extermination with the least expense and trouble. The crop rotation systems are great aids to soil improvement and to the eradication or holding in check of cotton wilt or black root and other fungus diseases and insect pests. Moreover, rotation of crops means diversified farming and

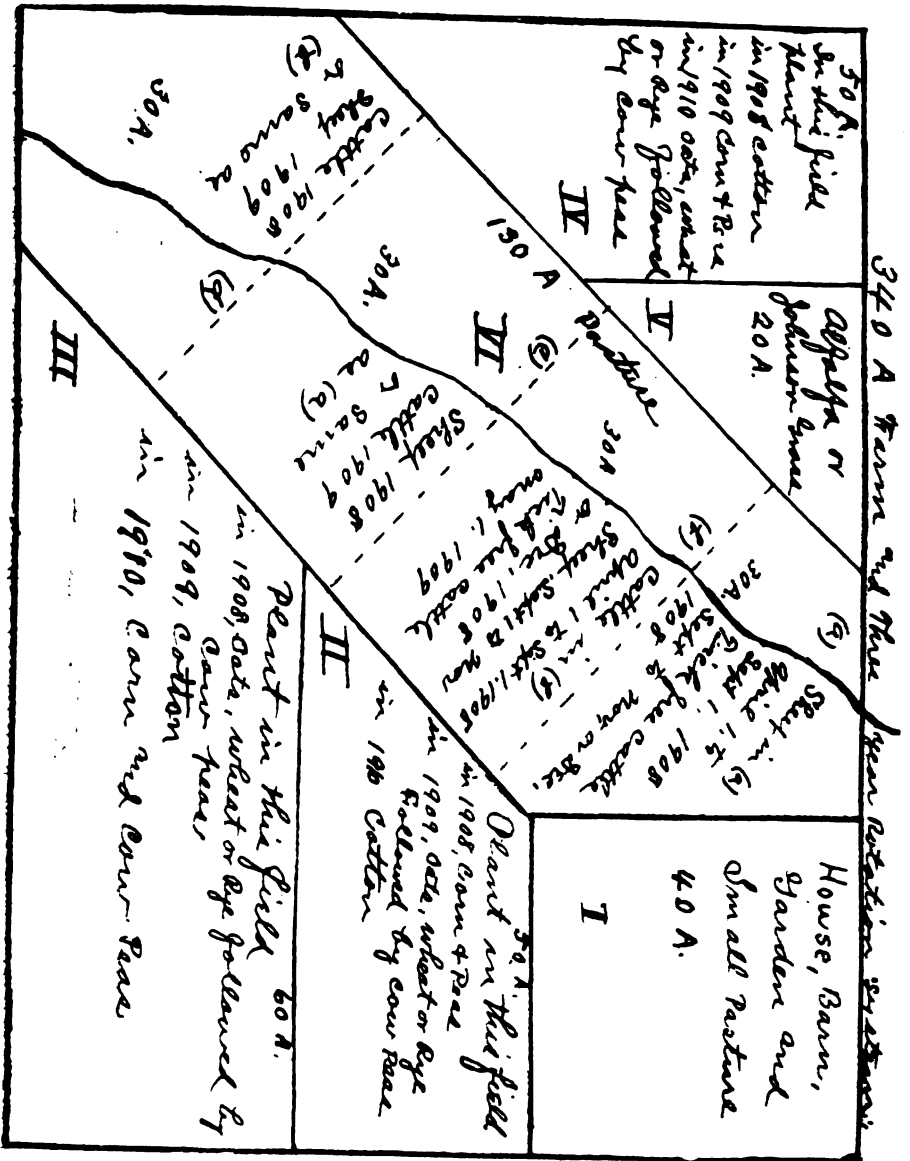
### 90 A. Farm and Three year Rotation System

<p>10 A. House, Barn and Garden Lots</p> <p>I</p>	<p>20 A. Pasture</p> <p>Keep cattle in here April to Oct or Nov. and graze cattle once every 10 to 15 days or as often as ticks are found on them.</p> <p>Brook or Creek</p>	
<p>20 A.</p> <p>In this field plant Cotton 1908 Corn + Peas 1909 Oats or Rye or Wheat or Barley followed by Cow Peas 1910</p> <p>Cattle in here after cotton is picked 1908 and early part of 1909.</p> <p>III</p>	<p>20 A.</p> <p>In this field plant Corn + Peas 1908 Oats, or Rye or Wheat or Barley followed by Cow Peas 1909 Cotton 1910</p> <p>Cattle may be kept in here after Sept or Oct. 1908</p> <p>IV</p>	<p>20 A.</p> <p>In this field plant Oats or Rye, or Wheat or Barley followed by Cow Peas 1908 Cotton 1909 Corn + Peas 1910</p> <p>Cattle in here after cow peas are cut in 1908</p> <p>V</p>

forces the farmer to feed live stock on his farm or lose soil fertility by selling feed, forage and hay. Again, feeding live stock and growing legumes and other forage crops on the farm increases the vegetable matter or humus in the soil. Humus can not be bought in commercial fertilizers and the old worn lands are almost universally deficient in vegetable matter.

The rotation systems suggested are not iron clad, and may not be suitable to every farm. Yet the tick inspector and the farmer can study these and if they are not suitable as a whole or in part to a special farm, these will suggest others or methods of preparing a system adapted to the special farm.

In the ninety acre farm and three year rotation system, the plan adopted for eradicating the tick is oiling method with the cattle kept in the pasture from April until October or November or until they can be turned into the field where cow peas have been harvested or into the field where corn and peas have been removed, or into the cotton field after it has been picked. On this farm pasture II could be divided May 1, and either plan (a) or (b) of starving out the ticks and greasing the cattle only twice just previous to putting them into tick free areas could be employed. This three year rotation system was first suggested by Director Redding of Georgia.



**FIG 8**

The rotation system on the 340 acre farm is the same as on the 90 acre farm. But the methods employed in eradicating the tick are different. The pasture VI is divided into four parts. In (a) the sheep, goats, or hogs are kept from April 1 to September or Oct. 1, then they are removed to (b) and the cattle in (b) are cleaned by thoroughly oiling them twice, with four days between each oiling) or apply any other effective cattle dip twice; then after the cattle are kept for a few days in a tick free lot or pasture, they may be put into (a).

Or, the pasture might be divided into just two parts and the same plan employed. Instead of putting the cattle back into (a) they could go into the corn and pea field or into the cowpea field after those crops have been harvested, and after the cotton is out put the cattle into the cotton field. Keep them in the cultivated fields during the late fall and winter, and put them back into (a) in April. The cattle could not be moved into (b) before May or June 1.

It would not be advisable to try to grow alfalfa in part V unless the land was lime land or made sweet by sowing sufficient air slaked lime or ground lime rock on it. Nor would I advise planting Johnson grass on this land, but if it is already there, make the best of it by cutting it for hay always before it goes to seed.

Recent investigations indicate that sheep may be carriers of cattle ticks. Hence, it may be necessary to keep them out of pasture or other places where it is desirable to starve out cattle ticks.



440 A. FARM Three year Rotation System				
20 A. House, Barn, Garden and Orchard Site I		III 120 A. Pasture		
30 A. II Pasture For Horses and Cattle	IV 80 A.	I 80 A		
	In this field plant wheat, followed by corn, peas, German millet, sorghum 1908 Or plant cotton 1908	In this field plant corn & cow peas. 1908. Oats and cow peas or Red Clover in 1909.		
III 30 A	Corn and cow peas 1909 Oats and cow peas or Red Clover (in next year.) 1910	In this field plant Oats and cow peas or Red Clover in 1908. Wheat followed by cow peas, sorghum and German millet 1910 Or cotton in 1910		
Cattle fields.		In this field plant Oats and cow peas or Red Clover in 1908. Wheat followed by cow peas, sorghum and German millet in 1909. Or cotton in 1909. Corn and cow peas in 1910.		

FIG. 7.

The rotation system on the 440 acre farm is also a three year system and very much like those given for the 90 acre and the 340 acre farms. But in this cotton is replaced, optional or divided with wheat followed by one or more of the following: cow peas, German millet, sorghum or soja beans. The oat crop is to be followed by cow peas, but red clover or alsike clover might be sown with the oats. Red clover, of course, could be used only in North Alabama.

The 120 acre pasture could be used for cattle and the cattle regularly oiled, or the pasture divided into two parts, on May 1 move all cattle, horses and mules into the part next to the house and barn. Keep all cattle, horses and mules out of the other part until October 1, then the clean cattle can be put into it. Or take all cattle, horses and mules out of the pasture about September 1 and keep the entire pasture closed to cattle, horses and mules until May 1 the next year; then put only tick clean cattle into the pasture.

## 460 A FARM. Five Year Rotation System

70 A Pasture Bernuda and Carpot grass Key cattle in line from April until Sept or Oct Strong. Sit or graze cattle once every 10 days or as open as line ticks are found in them	80 A. Hence, Burn warper, instead only 20 pig pasture	70 A. Pasture Bernuda and Carpot grass. Key cattle in line from April to Sept. Strong. Sit or graze cattle every 10 days or every 5 days if ticks are found in them.	60 A. Pasture Date or Wheat or Rye or barley followed by Cown + Rice in 1908 Bottom in 1909 Rice Clover or Heavy Wtd. in 1910 and Cown + Rice 1911
60 A. Bottom in 1908 Cown + Rice 1909 Rice Clover or Heavy Wtd. + Cown + Rice in 1910 Date followed by Cown + Rice 1911	50 A Pasture or Past of at many be planted in alfalfa	60 A. Rice Clover or Heavy Wtd. + Cown + Rice 1908 Date or Wheat followed by Cown + Rice 1909 Bottom in 1910 Cown + Rice 1911	60 A. Date or Wheat or Rye or barley followed by Cown + Rice in 1908 Bottom in 1909 Rice Clover or Heavy Wtd. and Cown + Rice 1911

FIG. 8.

The four-year rotation system given on the 460 acre farm plan is one that is intended for a farm where large quantities of forage or hay crops are desired for feeding live stock. Notice that the soil improving crops are very prominent. The cow peas after oats could be replaced by soja beans—especially after the land has been improved by the rotation system and the use of stable manure. On this farm are two 70 acre pastures and 150 acre pastures. To clean the cattle and the pastures of ticks, the oiling method may be adopted or either of the other methods can be used. With this number of pastures fenced and all of the separate cultivated fields fenced, it would be relatively easy to clean all the cattle and all the pastures. Keep all of the cattle in one of the 70 acre pastures from April 1 to Sept 1, then move them into the corn and peas or the cow pea field after they have been harvested; later put them into the cotton field, and then shift them about on the cultivated fields until April or May 1. At that time, if the cattle are not clean of ticks thoroughly oil them or dip them twice, with four days between each oiling or dipping and put them into the other 70 acre pasture, out of which they were moved September 1. Thus in one year all of the pastures and cattle can be readily cleaned of cattle ticks.

When a pasture is vacated by cattle May 1, the low, rich, open, bottom lands may be plowed in August or September and sowed in winter rye or barley. These will give green grazing in the winter varying in quantity according to the fertility of the land and the cold or warmth of the winter.

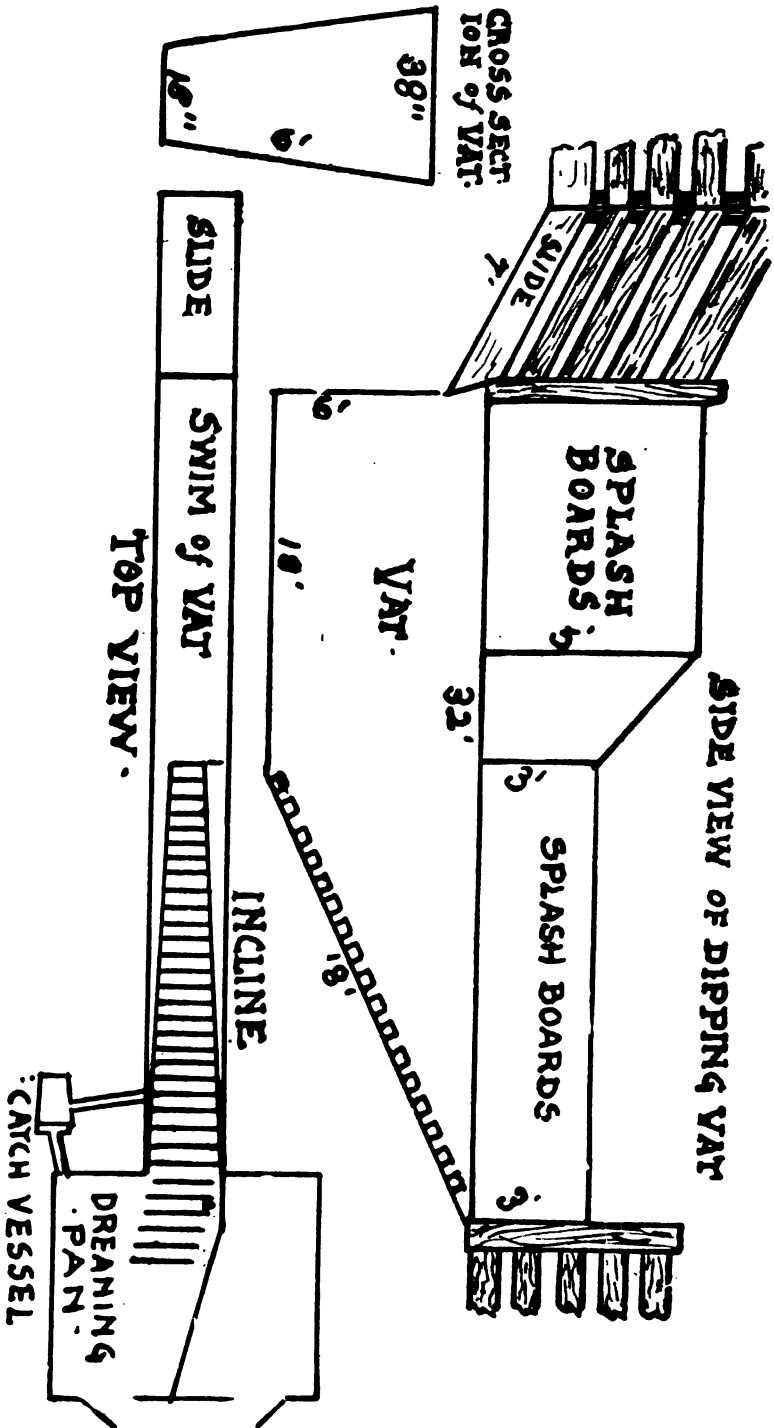


FIG. 9.

### HOW TO MAKE THE VAT.

Length of swim, 18 feet. Incline, 14 feet 1 in. "Slide," 7 to 8 ft., with drop of 3 ½ to 4 ft. Top width, 38 in. Bottom, 18 in. Depth, 6 ft. Set in ground 5 1-2 feet.

Frame with 2x4, every 16 to 18 inches.

Lay bottom of 2x18x18 ft. cypress. Then lay sides of 1x4 best flooring. Incline of 2x18x16 ft. cypress, cut in two pieces to fit, and dressed. Perpendicular end of same. "Slide" of good straight grained lumber, hardwood dressed, or soft wood covered with sheet-iron. It should be 7 feet long, with about a thirty degree slope. All joinings should be carefully fitted, and laid in coal tar or white lead. Quarter-round may be laid in angles to prevent leakage.

Dripping pen may be single or double. Should not drain into vat, but to one or both sides, where dip should be received into a suitable catch-vessel, through a screen, and allowed to settle before returning to vat, to get rid of filth. "Incline" and floor of dripping pen must be cleated.

A cover should be provided for the vat to prevent evaporation, which would concentrate the dip so that it would be of unknown strength and possibly unsafe to use. When not in use, drainage from dripping pen should be diverted from vat in case of rain, to prevent the dip in vat from being diluted.

Vat of the above measurements will require 2,000 gallons to fill 5½ feet deep. Dr. Parker, of Texas, wrote the specifications for this vat.

### BERMUDA.

Every permanent pasture in Alabama or the South should be set in Bermuda. All the upland and all the bottom lands that are not too wet are suitable places for it. The hill pasture lands should be terraced and set well in Bermuda. This will stop washing and hold fertility. The greatest mistake is made when one attempts to grow it on very poor, bare or washed land, without the use of fer-

tilizers. A complete commercial fertilizer, or stable manure will make it grow. When possible, it is always best to grow one or more crops of cow peas on the land after it has been terraced (if hill sides) and then plant in Bermuda. It is best to grow wheat, rye, barley, vetch or burr clover on the land in winter, between the times of growing the cow peas. These will act as catch crops, prevent the soil from washing and hold fertility. The best time to plant Bermuda roots or stems is during the wet weather in May, June or July. Dig up the Bermuda from a sodded place and be sure to avoid a place where nut grass or Johnson grass is growing. Also avoid carrying smut grass with the sod. The smut grass can be easily separated from the roots or stems of the Bermuda. Furrows may be opened from one to two feet apart and the Bermuda roots dropped into the furrows and covered with the plow. The Bermuda roots may be run through a corn cutter and then they will be more easily handled and will plant more ground. If the land is in corn, the Bermuda roots may be planted in the middles. This may prevent the corn from making a full crop, but with plenty of rain and fertile soil, it will make a good Bermuda sod. Burr clover or hairy vetch may be planted in the furrow with the Bermuda roots. The combination of Bermuda and burr clover will produce at least 10 months pasture in nearly every year. Bermuda on rich land will produce as much pasture as Kentucky blue grass will produce in Kentucky. Bermuda can be made to grow in the shade providing the soil is sufficiently fertile and the shade is not too dense. I have grown it under cedar trees, producing a solid sod. Its greatest enemies are smut grass and nut grass; and carpet grass will crowd it out of wet places. Japan clover is said to smother it some, but it will not do it only on poor land. In rich bottoms not too wet it will grow high enough to be cut for hay.

#### CARPET GRASS (*PASPALUM PLATYCAULE*).

This is also called blanket grass and Louisiana grass. It

grows readily on almost any kind of fertile soil. It will grow in the wet places where the Bermuda does not thrive and consequently it is often found covering the wet places in a Bermuda pasture. Grazing animals usually prefer it to Bermuda and will keep it eaten off close to the ground. It is said to crowd out weeds and other grasses, especially in wet places. The seed is expensive and it does not catch well from seed. Yet, when once started, it spreads rapidly—one plant is said to cover 10 to 20 square feet in one season. It is not a hay plant but an excellent pasture plant, ranking next to Bermuda in the South. It can be readily destroyed by plowing and cultivation.

#### RAPE.

Rape is a pasture plant for hogs and sheep, and may be used for cows and other animals.

It requires a rich loam soil well supplied with humus, or vegetable matter, and a complete fertilizer may be used on the soil to the amount of 300 to 800 pounds per acre. Plow the land well and deep, harrow and thoroughly pulverize by use of roller, clod crushers, and harrow. Sow from 3 to 5 pounds of Dwarf Essex seed per acre in drills or 6 to 8 pounds broadcast and brush over lightly.

It may be sown in summer, fall or spring, when the ground is moist enough to germinate the seed. When sufficiently large, graze it with hogs or sheep by using hurdles or by letting them run on all of it. It will continue to grow for several months, if not eaten down too closely to the ground or allowed to go to seed. It may be sown in between cotton or corn rows in August or September. It will not grow in dry seasons.

#### ALFALFA.

Alfalfa is a perennial forage plant which may be kept growing for twelve or more years, provided the weeds and its parasites do not kill it. Almost any fertile lime land, with no "hard pan" or rock near the surface, will



grow alfalfa. It is necessary to have the bottom land well drained, for alfalfa will not thrive in wet soil. One without any experience should begin with a few acres. Select good lime land, and if it is not lime land, apply, after plowing, on each acre 2,000 pounds of air slaked lime or 4,000 pounds of ground lime rock. It is best to apply the lime a short time before sowing the seed and harrow the plowed land to mix the lime well with the surface soil. It will not be necessary to apply the lime again for 5 to 8 years.

In preparing the land for alfalfa, it is best to begin one to three years before sowing the seed. Add all the stable manure you can each year to the land, and grow cow peas or soja beans in summer in drill and cultivate so as to kill out all the weeds. In winter time grow crimson clover, hairy vetch or wheat, rye or barley. After two or three years apply well rotted stable manure and 500 pounds of 16 per cent. acid phosphate per acre. Plow 10 to 15 inches deep with disc plow or one to two inches deeper than the land has ever been plowed with a three or four horse turn plow, following in each furrow with a long scooter or subsoiler. Harrow and roll until you have a finely pulverized seed bed. After cutting off the oats, wheat, rey, barley, crimson clover, or hairy vetch, the land could be kept cleanly cultivated by shallow plowing once every one or two weeks until the middle of August. Then the manure and phosphate could be applied and the land be plowed deeply, harrowed and rolled. After plowing, apply the lime or lime rock. Always do this previous to harrowing and rolling. Some time from the middle of August to last of September, sow 20 to 25 pounds of good alfalfa seed (free from weed seed). Sow it evenly and broadcast it. In order to inoculate the soil and the seed, secure 100 pounds of rich dirt or soil from any field where alfalfa, mellilotus, or burr clover is growing or has grown within a year of the time you take the soil. Place this soil in a box, wet the alfalfa seed and thoroughly mix it with the pulverized

soil in the box. Sow the soil and seed broadcast over the acre of prepared land and brush in lightly.

As a rule the young plants will get sufficiently large to resist the freezing and lifting frosts of winter, and the next spring the young alfalfa will grow so early and rapidly that it will keep down the weeds. But should you fail to get a stand from the fall sowing, the same land may be easily prepared for seeding again in the same way and at any time from March 1 to April 1.

When the little branches begin to start out from near the base of the stem or just about blooming time, the alfalfa should be cut, and after removing the hay, the alfalfa stubble, if weedy, may be harrowed with a tooth harrow to destroy weeds and loosen up the ground. And after the first summer every time it is cut, it may be run over with a disc harrow having the discs set straight and then run over it in a direction at right angles to the way that the disc harrow ran, with a tooth harrow. This kills and keeps down weeds, loosens up the soil, admits air, and retains moisture.

The essentials for growing alfalfa are lime, manure, fertile soil, and absence of weeds, grass and parasites.

Dodder, or "love vine," is one of the worst parasitic enemies of alfalfa. When once started, it may be kept in check by hoeing it out and all the alfalfa for several feet around it. Pile up the dodder and alfalfa in the center of the cleared space and burn it when dry. Do not allow anything to grow on these bare places for one or more years. As a rule, the only way to kill out dodder in an alfalfa patch is to plow up the alfalfa and put that land in cotton and then in corn. Crab grass and chick weeds are plants that will crowd out or choke out alfalfa.

#### CRIMSON CLOVER.

This clover grows best in the fall, winter and spring, and may be sown in between the cotton or corn rows from latter part of August up to the fifteenth of October. If the ground is rich or has been made fertile by using stable

manure on the corn or cotton, 200 to 500 pounds of 16 per cent. acid phosphate and a little potash may be all the fertilizer required. Sow 20 pounds of good seed and cover with small harrow or shallow cultivation. If it is to be sown on freshly plowed land, it is best to run the roller over the ground after harrowing in the seed. When possible, secure 100 pounds of dirt from a field where red, white, or alsike clover or crimson clover has been grown luxuriantly within one year. Wet the 20 pounds of crimson clover seed and then thoroughly mix the 100 pounds of dirt with the seed. Now sow the mixture of dirt and seed on the freshly harrowed land. Harrow again after sewing, and then roll the land, if not in corn or cotton. This is to inoculate the seed and the land. It will not do to sow it in the late fall, in winter, in spring, or in early summer. It will be ready for cutting when it blooms in May or early June. It can be followed by cow peas, sorghum, soja beans, or late corn. In case you can not secure inoculated soil for inoculating the seed as above directed, use plenty of stable manure on a small piece of fertile land, and the next year the soil from this land will do for inoculating more seed and land. To be sure that a given soil is inoculated, examine the rootlets of the young or old clover plants growing on the land, for the bunches of little nodules. When the land does not contain lime, an application of 1,000 to 2,000 pounds of air slaked lime to the land before sowing the seed will help the growth of crimson clover. It should not be planted on wet land, or low undrained wet land.

#### HAIRY VETCH.

One of the best legumes for collecting the nitrogen from the air, for making proteid or nitrogenous forage which is equal to wheat bran in feeding value, and for adding vegetable matter and nitrogen to the soil, is hairy vetch. It does not require lime land but some claim that it will grow best on sweet soil. It may be planted with winter oats, wheat, rye, or barley. But, as a rule, it does best

with oats. Yet it is rare that any of these cereals are ready for making the best hay when the hairy vetch is in bloom and ready for cutting. It can be sown on Bermuda sod in June, July or August. If the Bermuda is on rich land and is not pastured too close, the hairy vetch will take hold and grow vigorously after the fall rains. It would be better to cut up or scarify Bermuda sod with a scooter or some other plow and then sow the seed and harrow with a disc harrow. Hairy vetch may be drilled or sown in between the corn, sorghum, or cotton rows in August or September. If sown by hand, cover by shallow cultivation. It is well to use 300 to 500 pounds of 16 per cent. acid phosphate on each acre of land and a little potash. And if not inoculated, use plenty of stable manure. The seed and the land can be inoculated by getting a 100 pounds or more dirt from a field where hairy vetch or some other vetch grew the previous year or season, or from a place in the garden where English peas grew the previous year or season. Wet the seed with water and then mix the seed and dirt. Sow the mixture of dirt and seed over freshly harrowed or plowed land, and harrow again and then roll the land. This plant will stand more freezing than rye. Sow about thirty pounds of seed per acre. If used with oats or wheat, sow 1 to 2 pecks of hairy vetch seed with one to one and a half bushels of oats or wheat. The vetch seed may be sown with the inoculated dirt and then the wheat or oats can be sown broadcast or drilled.

#### ALSIKE AND RED CLOVER.

It is doubtful if either of these two clovers can be successfully grown anywhere south of the Tennessee river valley in Alabama. In all places where the land is "clover sick" for red clover, use alsike. Here I can not do better than quote a letter from Director H. A. Morgan of the Tennessee station: "Regarding the preparation of land for alsike clover or red clover, we handle it something this way: In order to rid the land of weeds, which are

natural upon most of our lands, put the land in peas, after making an application of lime—three or four thousand pounds to the acre of ground limestone rock and about two thousand pounds of the burnt lime. Disc this into the surface of the plowed ground a week or two before sowing the peas. After the peas are taken off, the land may be sown to a winter cereal, such as rye, wheat or fall oats, and, in early spring, seed to alsike clover, putting in plenty of good seed. We use as much as 10 to 12 pounds to the acre on our poor lands.

I do not believe, from our experience here, that it would be wise for you to recommend red clover until sufficient seed from immunized clover plants can be procured. Red clover is universally affected with a species of *Colletotrichum*, an anthracnose, and in the Middle Southern States undoubtedly dies from this disease. We have every promise, from our experiments with clover this year, finally to work out immune varieties, and I hope that this will be only a matter of three or four years. In the meantime, we are recommending alsike on well limed land. Alsike, as you remember noticing when at the station, is exceedingly sensitive to an acid soil, and therefore accepts beautifully a lime application.

#### MELLILOTUS OR SWEET CLOVER.

For the redemption of bare, poor lime lands no plant equals mellilotus. It is a biennial and when once started will readily reseed itself if not kept from going to seed by frequent cutting with the mover.

The land should be well prepared and the seed sown in September or March, at the rate of 15 to 20 pounds per acre. It will do well on lime land where Johnson grass has a good hold. If cut early it will make good hay. It will also stand pasturing, but at first some animals must be kept on it for several days before they will eat it. The seed can be inoculated with dirt from an old mellilotus field or from a field of alfalfa or burr clover.

**BURR CLOVER.**

This is a close relative of alfalfa and is an excellent winter growing plant. It will grow on almost any kind of fertile soil that is not too wet. But it will grow best on lime land. It may be sown broadcast in between the cotton or corn rows just before the last plowing in June or July, using 2 to 3 bushels in the burr. Do not use the California burr clover seed. It can be sown broadcast, in June, July or August on scarified Bermuda sod, or on disced wheat, rye or barley stubble. If the seed with the burr removed is used, it may be sown as late as September. It is well to roll the land after harrowing in the seed that is sown in September. If not eaten off too close in the spring, it will reseed itself. In South Alabama it will furnish good winter pasture from December to April. Very cold weather may freeze back the top growth, but warm weather will bring it out again. As a rule the seed in the burr is inoculated, but it can be inoculated by using dirt from a mellilotus field, an alfalfa field, or a burr clover field. It is best to inoculate the seed that is cleaned of the burr, or use plenty of stable manure. Do not attempt to grow it on poor soil. Better grow a crop of cow peas on the land and then fertilize well before trying burr clover. This is not a good hay plant. Better plant hairy vetch, crimson clover, or red clover, or alsike clover for hay. Burr clover is a winter and spring plant.

No. 333.)

AN ACT.

(S. 165.)

To establish a State Live Stock Sanitary Board and the office of State Veterinarian in order to further protect live stock from contagious and infectious diseases and provide for eradicating and excluding such diseases from Alabama.

Section 1. Be it enacted by the Legislature of Alabama, That from and after the passage of this act, the commissioner of agriculture and industries of the State of Alabama, the State health officer of Alabama, the pro-

fessor of animal industry and the professor of veterinary science, of the Alabama Polytechnic Institute shall, ex-officio, constitute a board to be known as the State Live Stock Sanitary Board. The commissioner of agriculture and industries shall be chairman and the veterinarian on the board shall act as secretary of the board. The State Live Stock Sanitary Board shall have full power to make or enact such rules and regulations as they may deem necessary for governing the movements, transportation or disposition of live stock that may be quarantined as hereinafter provided, on account of being affected with, or exposed to, a contagious or communicable disease, or on account of being infected or infested with the carrier or the carriers of the cause or the causes of a contagious infectious or communicable disease of live stock.

Sec. 2. Be it further enacted, That the professor of veterinary science of the Alabama Polytechnic Institute shall act as State Veterinarian of Alabama. The State veterinarian shall nominate, and the State Live Stock Sanitary Board shall elect, as many assistant State veterinarians and State live stock inspectors as they may deem necessary and as the funds at their disposal shall permit.

Sec. 3. Be it further enacted, That the State veterinarian is authorized and directed to quarantine a stall, lot, yard, pasture, field, farm, town, city, township, county, or any part of the State of Alabama when he shall determine the fact that live stock in such place or places are affected with a contagious, infectious, or communicable disease, or when said live stock are infested or infected with the carrier or the carriers of a contagious, infectious or communicable disease. The State Veterinarian or an assistant State Veterinarian shall give written or printed notices of the establishment of said quarantine to the owners or keepers of said live stock, and to the proper officers of railroad, steamboat, or other transportation companies doing business in or through the quarantined part or parts of the State.

Sec. 4. Be it further enacted, That no railroad company, or the owners or masters of any steam or other vessel or boat shall receive for transportation or shall transport live stock from any quarantined part into any other part of Alabama except as hereinafter provided. No person, corporation or company shall deliver live stock for transportation to any railroad company or sailing or steam vessel or boat in a quarantined part of Alabama, except as hereinafter provided. No person, company or corporation shall drive or cause to be driven, live stock on foot, or transport live stock in a private conveyance, or cause live stock to be transported in a private conveyance from a quarantined part to a non-quarantined part of Alabama, except as hereinafter provided.

Sec. 5. Be it further enacted, That live stock may be moved within the limits of a quarantined part or from a quarantined part of Alabama only under, and in compliance with, the rules and regulations of the State Live Stock Sanitary Board. It shall be unlawful to move or allow to be moved, any live stock from one place to another within the limits of a quarantined or from a quarantined part to a non-quarantined part of Alabama, in any other manner or method, or under any conditions other than those prescribed by the rules and regulations of the State Live Stock Sanitary Board.

Sec. 6. Be it further enacted, That all live stock, except such live stock as are to be used for immediate slaughter, when brought into Alabama by a person, company, corporation, railroad or other transportation companies, shall be accompanied by a certificate of health, and said certificate shall state that said animal or animals are free of contagious, infectious or communicable disease and the carrier or the carriers of the cause or the causes of such diseases. This certificate must be made by a qualified veterinarian immediately after he has personally examined the live stock and before the live stock has been shipped into Alabama. This certificate shall be attached to, and accompany, the shipping bill of the live stock to



the place to which the live stock is shipped, and the owner of the live stock or agent of the transportation company shall mail or send said certificate to the State veterinarian, immediately following the arrival of the live stock at its place of destination. The State veterinarian shall furnish qualified veterinarians and transportation companies with blank health certificates at actual cost.

Sec. 7. Be it further enacted, That owners, renters, or parties in possession of quarantined live stock or quarantined places shall follow the directions in the rules and regulations of the State Live Stock Sanitary Board in cleaning and disinfecting infected live stock and infested or infected quarantined places, and in destroying the carriers of the cause of a contagious, infectious or communicable disease, that infest or infect live stock and quarantined places. Said cleaning of said live stock and the disinfecting of said places and destroying of said carriers shall be done by the owners, or the parties in possession of the infected live stock and places, in a reasonable time after receiving a written or printed notice from the State veterinarian, an assistant State veterinarian, or a State live stock inspector. Any person, company or corporation violating the provisions of this section shall be guilty of a misdemeanor and on conviction, shall be punished for each and every violation by a fine not less than ten dollars, nor more than one hundred dollars, or by imprisonment not less than ten days nor more than sixty days, or by both such fine and imprisonment.

Sec. 8. Be it further enacted, That the State veterinarian, the assistant State veterinarian and the State live stock inspectors are hereby empowered to enter upon the premises or into any barns or other buildings where live stock are temporarily or permanently kept in the State of Alabama in the discharge of the duties prescribed in this act. Any person or persons who forcibly assault, resist, oppose, prevent, impede, or interfere with the State veterinarian, an assistant State veterinarian, or a State live stock inspector in the execution of his or their

duties, or on account of the execution of his or their duties, on conviction, shall be punished as provided in Section 11 of this act.

Sec. 9. Be it further enacted, That the work of cattle tick eradication or the suppression or eradication of any other infectious, contagious or communicable disease of live stock shall be taken up under the provisions of this act in any county or any part of a county or any part of the State of Alabama, when the State Live Stock Sanitary Board may deem it best. The county commissioners of any county in which the State or Federal authorities take up the work of tick eradication or the suppression of any infectious, contagious or communicable disease of live stock, may appropriate, for aiding in such work, such sum as the county commissioners may deem adequate and necessary.

Sec. 10. Be it further enacted, That the State Live Stock Sanitary Board may appoint or elect the Federal veterinarians and live stock inspectors, who are doing work in Alabama, as assistant State veterinarians and State live stock inspectors; provided, they consent to act without pay from the State of Alabama.

Sec. 11. Be it further enacted, That any person, persons, company or corporation violating the provisions of Sections 4, 5, 6 or 8, of this act, shall be guilty of a misdemeanor and, on conviction, shall be punished by a fine of not less than fifty dollars, nor more than five hundred dollars, or by imprisonment of not less than one month nor more than six months, or by both fine and imprisonment.

Sec. 12. Be it further enacted, That there is hereby appropriated annually the sum of five thousand dollars to be disbursed under the direction of the State Live Stock Sanitary Board to pay the actual expenses of the Live Stock Sanitary Board in attending meetings; to pay for the printing of the official blanks, the annual reports of the State veterinarian and the rules and regulations of the Live Stock Sanitary Board, to pay the State

veterinarian five hundred dollars per year and expenses while on actual duty; each assistant State veterinarian five dollars per day and expenses while on actual duty, and each State live stock inspector one to three dollars per day and expenses while on actual duty; and to pay such other expenses as may be necessary in carrying out the provisions of this act.

Sec. 13. Be it further enacted, That the judges of the circuit and criminal courts shall give this act in special charge to each future grand jury empanelled in this State, and that such grand jury be clothed with, and authorized to exercise inquisitorial power for the carrying out, and the enforcement of, this act.

Sec. 14. Be it further enacted, That the State veterinarian shall make an annual report to the Governor of Alabama, giving a full account of the work done and a detailed report of the money expended.

Sec. 15. Be it further enacted, That all acts not in accord with this act, are hereby repealed.

Approved March 12, 1907.

Official:

Frank N. Julian, Secretary of State.



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**MARCH, 1908.**

**ALABAMA**  
**Agricultural Experiment Station**

**OF THE**

**Alabama Polytechnic Institute**

**AUBURN**

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**Corn Breeding in Alabama**

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**By**

**E. MEAD WILCOX, Ph. D.,**

**Plant Physiologist and Pathologist.**

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The Bulletins of this Station will be sent free to any citizen of the State on application to the Agricultural Experiment Station, Auburn, Ala.

## INTRODUCTION.

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During the past decade a very large amount of attention has been given to corn breeding, particularly in the corn belt, by the various Experiment Stations and the United States Department of Agriculture. The practical value of such work has been so apparent that several private corn growers have undertaken the work and have made important contributions to our knowledge of the subject. The net result is that we now have a rather extensive literature that is freely available to all who are interested in this line of investigation. Several factors contributed to show the necessity of undertaking this line of work in Alabama, among the most important of which we mention:—(A) the low average yield per acre of corn. (B) the high market price of corn, and (C) the increasing need of a larger corn yield as feed for the rapidly increasing number of live stock being grown in this State. Besides it seemed important to undertake this line of work here to show exactly what could be done in developing a type of corn better suited to our needs in this latitude and one giving higher yields than the sorts in common cultivation. We therefore arranged to undertake this work, and in 1905 planted the first breeding plot. All of our corn-breeding work has been done on the "Hurstview" farm near Montgomery, and to Mr. Jesse M. Jones much credit is due for his very intelligent interest in the work and for numerous valuable suggestions made from time to time. My personal thanks are due to the Funk Brothers, Bloomington, Illinois, Professor P. G. Holden, of the Iowa Agricultural College, and Dr. Cyril G. Hopkins, of the University of Illinois, for numerous kindnesses and suggestions while visiting their institutions.

I am also under great obligations to various seedsmen and corn growers for seed furnished for the first year's work.

In this Bulletin we have given a summary of the most important practical results secured, but have purposely postponed for subsequent treatment some of the theoreti-

cal questions that have come to light during the work. The writer has not had a very large amount of time in the past to devote to this line of work, but it is to be hoped that the very satisfactory results secured will cause several progressive farmers to undertake similar work on their own farms. During the present season the author proposes to continue and intensify this line of work along certain important lines.

#### VARIETY OF CORN EMPLOYED.

The original ears employed in the first breeding plot were secured from the Mississippi Experiment Station and were of the sort called Mosby's Prolific. This is a corn of medium sized ear having white kernels on a white cob and with the stalk characteristics of the other prolific varieties. The mere name of the variety is of much less importance than its characteristics which have been found to be very well suited to the soil and climatic conditions of central Alabama where this work has been done. And yet the corn we have today differs in several marked particulars from the ears with which we started.

The following table shows the variation as to number of rows per ear for those ears planted each year in the breeding plots, in percentages.

Rows per ear	12	14	16	18	20
1905	1.66	43.33	50.00	3.33	1.66
1906	10.20	55.09	31.62	3.06	0.00
1907	9.18	52.03	28.56	8.16	2.04

It should be understood that no attention was given to the number of rows per ear in selecting the ears for the breeding plots.

The small cob generally found in the prolific sorts like Mosby has an advantage that in the South is of greater value than is ordinarily considered. A large cob is generally very sappy at harvest time, and thus such ears dry out more slowly than small ones, and the kernels are more easily injured by unfavorable temperature conditions and are more subject to rotting.

## OBJECTS OF CORN BREEDING.

All plant breeding has for its object principally an economic one, i. e., the improvement of the plant with reference to some character considered important to man. This character may be one of yield, chemical composition or some mere question of beauty as in the case of decorative plants and flowers. In all cases the methods are much the same. The prime object in corn-breeding is the increase of yield and the development of sorts best adapted to the soils on which they are to be grown and to the climatic conditions there prevailing. In the Illinois work one of the main objects has been to develop strains of corn rich in one or more of the chemical compounds found in the kernel. As a result they have developed a "high-protein" corn and a "high-oil" corn and also a "high-combination" corn, i. e., one high in both protein and oil. But for the Alabama farmer the main point at present is to increase the yield. The present average yield in Alabama, according to the last census, is about 13 bushels per acre. The purpose of corn-breeding is to largely increase this low yield. And our results show that this object can readily be accomplished.

We must keep in mind, however, the desirability of correlating the high-yielding tendency with some character of the ear or stalk so that we can predict from a mere physical examination the probable yielding tendency of the progeny of a given ear or stalk. There can hardly be any question that uniformity of stalk and ear is a quality that we should strive to secure. As an example and illustration of what is meant by uniformity or conformity to type in the ear see Plate 2. A study of the ears shown on plates 3 to 7 inclusive will show that we have materially increased the uniformity of the Mosby corn.

It will no doubt be found desirable to secure by breeding and selection sorts of corn adapted to the various soil types found in the State. These soil types not only imply soils of different chemical and physical nature, but in many cases involve distinct methods of cultivation. In other words the methods of cultivation adapted to the sandy soils



of the wire-grass region would scarcely be desirable for the black-belt or vice versa. We would be pleased to undertake co-operative work in corn breeding with several farmers in various parts of the State to test some of these questions and to demonstrate the highly satisfactory results secured by intelligent selection.

### THE EAR-ROW METHOD.

The ear-row method of corn breeding, which we are using, depends upon the well known individuality of the ear, i. e., its ability to transmit to its progeny various characteristics that it in turn has received from its ancestors.

The method may be briefly described as follows: We select 98 ears to be planted in what we call a "breeding plot" The tip and butt kernels are removed from each of these ears and the balance of the corn from each ear is planted in a row to itself. In our work we have planted the corn by machine in checks three feet and eight inches apart in both directions. One should have 98 rows from as many different ears and should mark each row with its proper number. The rows should be 100 hills long and in each hill just two stalks should be allowed to grow. This will save much calculation when the results are being worked up for comparison of the different rows.

During the growing season this breeding-plot is to be carefully watched to note any peculiarities that may appear in any of the rows. Plate 1 shows one row in one of the breeding plots that started its growth much more slowly than the adjacent rows. And as a matter of fact, the harvest showed conclusively that the ear from which this row was planted must have been weak in some particular. The progeny of this row does not enter into our subsequent work, as the yield from it was so low it was at once eliminated. Care should be taken to note any barren stalks and to detassel them at once to prevent the pollen from such worthless stalks falling upon the silks of any of the other stalks and thus perhaps perpetuating this tendency towards barrenness. One should also be on the lookout

for the finest stalks as to strength and number of good ears on them, and such stalks should be marked so that they can be told when the corn is harvested.

Desirable stalks are marked during the summer with tags of the form shown below :

○	
Row .....	Ear No. ....
<b>Stalk</b>	
Height .....	M.
Diameter .....	Cm.
<b>Leaves</b>	
No. ....	
Length .....	Cm.
Width .....	Cm.
<b>Ears</b>	
No. to Stalk .....	
Height .....	Cm.
Angle .....	
<b>Ear Stalk</b>	
Length .....	Cm.
Diameter .....	Cm.

At harvest time the ears selected for breeding purposes are marked in the following manner to show their origin and to connect them with the above data regarding the stalk on which they are produced. An ordinary gun wad has written on it the row and ear number, and this is attached to the butt of the ear by means of a strong pin known in the trade as "Bank Pins". These pins are driven into the butt of the ear, and in this manner the wad is rarely lost and can readily be seen when studying the ears in the laboratory. We of course gather a much larger number of ears in this manner than we subsequently use in the breeding plot, but for each ear we have all the data recorded on the tag referred to above.

## BREEDING RECORDS.

It is absolutely necessary that detailed records be kept showing every character of each ear planted in the breeding plot. It is only by so doing that any definite progress can be made. For our work we are employing the following forms.

The form shown on page 9 is the one used in keeping our records of the characters of individual ears planted in the breeding plot. Our register number is so made as to indicate the crop-year in which the ear was produced, and the last two figures show the row number in which said ear is planted. For example, Register Number 642 shows that that ear was grown in 1906, and that it was planted in row 42 of 1907. We are attaching to each of these forms a photograph of the ear so that we believe we have a very satisfactory record of the ears we have employed.

The form shown on page 10 is the front page of our field record form. The form shown on page 11 is the back of this same sheet. This sheet is filled out for each row and gives us the exact performance record of each ear planted in the breeding plot.

Annual Ear No.											
PLANT			EAR		COB		KERNELS		Chem. Analysis		
Row No.			Weight		Weight		% Corn to Ear		Protein		
Plant No.			Length		Tip Circ.		Breadth		Oil		
Height			Shape		Butt Circ.		Depth		Starch		
Height of Lowest Ear			Tip		Color		Shape		Ash		
Height of Highest Ear			Butt				Indentation		Moisture		
No. of Ears			Tip Circ.				Color				
Ear-Angle			Butt Circ.								
Ear-Stalk			No. of Rows								
			Kernels to Row								
			Sulci								

(DEvised BY E. MEAD WILCOX, 1904.)

Variety	Ear Reg. No.		Field					
Source			Row No.					
First	All	Average	1	2	3	4	5	Av.
Plant Up								
Tassel Out								
Silks Out								
Ear Mature								
Plants with marketable ears	Total	%						
Number of marketable ears								
Plants without marketable ears								
Number of unmarketable ears								
Barren stalks								
Leaning and fallen stalks								
Plants with suckers								
Number of suckers								
Smutted plants								

(Devised By E. Mead Wilcox 1907)

Planted

Harvested

	Number of Stalks	Total No. of Ears	No. of Ears per Stalk	Wt. of Ears per Stalk	Total No. of Ears	Total Wt. of Ears	No. of Mark. Ears	Wt. of Mark. Ears	Av. Wt. per Ear
Row									
Acre									

### CULTURE METHODS

Notes

How Planted

Distance between rows

1st cultivation

2nd cultivation

3rd cultivation

Thinned

Replanted

Barren stalks detached

Rows detached

## POLLINATION AND DETASSELING.

It has been estimated that a single tassel may produce as many as 50,000,000 pollen grains each one of which is sufficient to fertilize one ovule and produce one kernel of corn. These pollen grains to do this must fall upon the end of a silk that is ready to be fertilized, and there the pollen grain grows and sends a fertilizing tube down into the ovule at the base of the silk. The silks that are connected with the kernels at the base of the ear are fertilized first, and then from there towards the tip of the ear the work goes on. For each silk and each kernel therefore a single pollen grain is required. These pollen grains are blown about by the wind and may travel for some distance before falling on a silk. Of course large numbers are produced to be certain that enough fall on the silks to fertilize each one.

Now we may recognize three types of pollination or fertilization as follows:

1. The ovules of an ear are fertilized by the pollen of the tassel on the same stalk. This is called inbreeding, or self-pollination.

2. The ovules of an ear are fertilized by the pollen from the tassel of a stalk that arose from kernels produced on one and the same ear. That is these stalks might be called sister stalks and this type is called close-breeding or close-pollination.

3. The ovules of an ear are fertilized by the pollen of the tassel of a stalk not closely related to the ear stalk. This type is called cross-pollination or cross-breeding.

Now in the field and in the ordinary breeding plot some inbreeding probably occurs, but in the breeding plot we may have continuous and injurious amounts of close-breeding and this must be prevented. This is to be prevented by detasseling and gathering the seed corn for the next year's breeding plot from the detasseled rows alone.

Our plan is shown by the following diagram in which stars show stalks not detasseled and D denotes detasseled

stalks. Of course the diagram does not show all the stalks in the plot, and shows only ten of the rows:

D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D

In other words, it is seen that we detassel alternate halves of adjacent rows. Our seed corn is then gathered only from the halves of each row that have been detasseled.

This work of removing the tassels can not be done at one time, but must be looked after at intervals of a week or more until the tassels cease appearing. Just before the tassel is exposed one can, by gently opening the leaves, take a firm grasp on the tassel and remove it by a steady pull, without injuring the stalk at all.

#### CULTIVATION OF THE BREEDING PLOT.

The important thing in corn culture is frequent and shallow cultivation. Our breeding plot receives 4 to 6 cultivations and one or more hoeings. Too good care cannot be taken of the breeding plot, for from it you are to secure your improved corn for future planting. At harvest time the plot should be free of weeds, at least this is the ideal condition towards which you should aim. For further information on this subject, and upon the question of fertilizers and other matters of this nature see the Bulletins of the Alabama and Georgia Experiment Stations on Corn Culture.

#### SOME RESULTS SECURED.

The increase in yield we have secured is well shown by the following table, which gives the percentage of the rows each year that have been above and the percentage of the



rows that were below the average yield for all the rows of that year:

	Average.	P.C. of rows above.	P.C. of rows below.
1905	30.79	41.6	58.4
1906	36.62	47.9	52.1
1907	36.85	50.0	50.0

A comparison of the average or mean yield for 1905 with that for 1907 shows that we have increased the yield in three years 19.6 per cent.

The following table gives the yields of the fourteen best rows of the crop of 1907, together with the yields of the rows during the two preceding years which have been the ancestors on the female side of each of the fourteen ears. The yields are given in bushels per acre as calculated from the actual yields of the rows. In each case the yield is calculated to a perfect stand:

1907	1906	1905
642	537	425
53.7	41.9	43.9
650	550	433
51.2	36.2	58.2
691	539	435
49.2	50.4	35.4
652	522	429
46.9	37.7	37.7
623	535	445
45.3	40.8	34.7
661	551	422
45.1	43.9	35.1
649	593	458
44.1	39.6	39.8
656	527	429
42.9	35.6	37.7
630	510	443
42.3	49.9	39.8

684	510	443
42.1	49.9	39.8
647	577	418
41.6	45.3	31.6
645	583	417
40.8	40.0	25.2
653	519	426
40.5	37.9	42.9
646	513	425
40.5	35.2	43.9

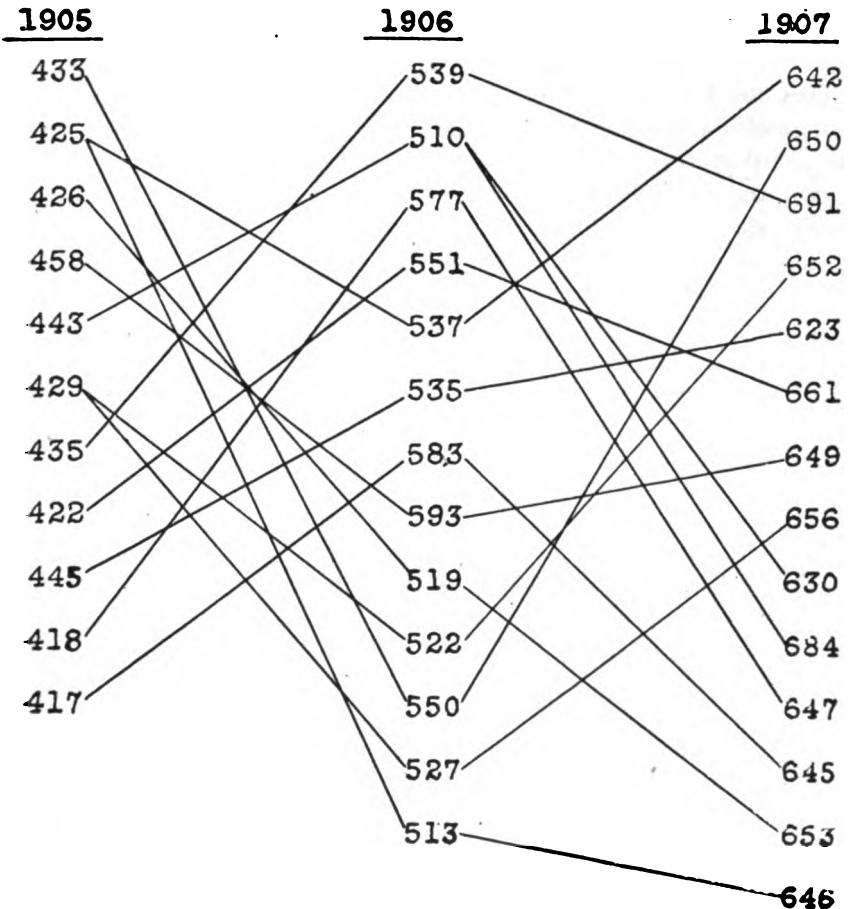


FIG. 1. Chart showing the pedigree of the fourteen best rows of the 1907 crop.

### TESTS OF MOSBY CORN BY FARMERS.

The following yields are taken at random from a larger number of reports made by farmers in various parts of the State who have planted corn purchased from Mr. Jones. This corn was taken from the breeding plot of 1906:

J. G. Little, Greenville, 60 bushels.

Clark Adams, Greenville, 65 bushels.

Geo. A. Watson, Monroeville, 72.5 bushels.

W. M. Newton, Belleville, 97.75 bushels.

H. E. Hudson, Monroeville, 30 bushels.

### HOW TO BEGIN CORN-BREEDING.

A farmer who desires to begin the systematic selection of corn should proceed as follows: During this season study carefully your field of corn and select enough of the best stalks to give you at least 200 ears. It does not matter about the name of the corn so much as it does about its being suited to your local conditions and to yourself. Where the land will stand it you had best select one of the prolific sorts, but under other conditions a 1-eared sort may be better. Allow the ears so selected to mature on the stalks, and under no circumstances "pull" the fodder from these stalks. When mature gather these ears and tag them in such a way that you will know the sort of a stalk each came from. These ears constitute your basis for further improvement, and should be well cared for during the winter.

### PREVENTING INJURY BY WEEVILS AND MICE.

The corn for the breeding plot should be stored during the winter in some dry and cool place and in some barrel or box to which mice cannot enter, and tight enough to permit of fumigation against weevils. A good method to fumigate against weevils is to place the ears in a tight box or barrel and place an ordinary tea cup half full of carbon bisulphid on top of the corn and cover the whole with a blanket. After twenty-four hours every weevil will be dead. The corn should then be examined at intervals dur-

ing the winter to see that weevils or mice have not entered the barrel.

### SELECTING THE EARS FOR THE BREEDING PLOT.

During the winter while you have time study these 200 ears by means of the score card, and from them select the 98 best ears for the breeding plot.

### THE SCORE CARD AND CORN JUDGING.

The main value of the score card to the corn grower is that it causes him to give close attention to the various characters of the ear and teaches him the most desirable features to be looked for in the corn he is breeding. We are well aware that in the ordinary corn shows and in ordinary corn judging little or no attention is given to the relative yields of the ancestors of the various ears being compared. In other words the ears in the exhibit are compared to one another without any reference to the performance record of their parents which may well be expected to appear in the progeny of the ears. For example, it might be possible to gather two samples showing equal perfection as to the points mentioned on the score card, but one sample might have come from a field yielding 50 bushels to the acre and the other from a nearby field yielding but 10 bushels to the acre. But from his high yielding rows in the breeding plot the corn grower must be able to select the ears which are best from the standpoint of the score card.

It must be left to future work to develop a score card that is well adjusted to our Alabama types of corn and for the present we offer the score card employed by the author in order to call attention to this line of work:

1. Uniformity.
  - A. Trueness to type ..... 10
  - B. Uniformity of exhibit ..... 5
2. Shape of ear ..... 5
3. Color ..... 10
4. Market condition. .... 10
5. Tips ..... 5

6. Butts .....	10
7. Kernel uniformity .....	5
8. Kernel shape .....	5
9. Length .....	10
10. Space.	
A. Space between rows .....	5
B. Space between kernels at the cob.....	5
11. Percentage of corn to cob .....	15
<hr/>	
Total .....	100

### SUGGESTIONS AS TO USE OF SCORE CARD ON MOSBY CORN.

1. The deficiency and excess in length of the ears that do not conform to the standard for the variety shall be added together and a cut of one point made for each inch thus secured. For the Mosby corn the standard length shall be 8 inches.

2. The deficiency and excess in circumference of all the ears that do not conform to the standard for the variety shall be added together, and for every two inches thus secured a cut of one point shall be made. The standard circumference, taken at one-third the distance from butt to tip, in the Mosby corn shall be 6 inches.

3. The shape of the ear in the standard is such that the proportion between length and circumference is the same as 4 to 3. Cut each ear that is off, 1-2 point.

4. For kernels off in color, i. e., yellow in the case of Mosby corn, cut 1-4 point for each two kernels. That is for 6 yellow kernels, cut the ear 3-4 point.

5. For a red cob in Mosby corn cut each ear 2 points.

6. Vitality is indicated finally by the germination test, but this is out of the question for score card purposes. The ears should be well-matured, firm and sound. For each ear that is off cut 1-2 point.

9. The kernels should be of uniform shape and true to the type. For each ear that is off cut 1-2 point.

10. The kernels should be so shaped that their edges touch from tip to crown. Cut 1-2 point for each two kernels not so shaped.

11. The proportion of corn to ear should be from 85 to 90 per cent. in the case of the Mosby corn. For every per cent below this standard cut the exhibit 1-2 point.

### TESTING THE VITALITY OF SEED CORN.

This should never be neglected for the breeding plot, and would prove of great value even in the general fields. When we remember that 15 to 20 ears should give plenty of corn to plant an acre, we see that the time and labor to test enough corn for even large fields is not very great. It will certainly pay in better stands of corn and larger yields. The method is simple and requires no expensive apparatus. A box should be made 12 by 18 inches inside and about 3 inches deep. Do not make this water tight. At the bottom of this place two thicknesses of canton flannel moistened with water. The upper side of this cloth should be marked off into squares 2 inches square with a lead pencil. These squares should be numbered from 1 to 54. Now from the ears numbered in the same manner remove six kernels as follows: Near the base of the ear remove two kernels on opposite sides of the ear. Near the tip select two kernels also on opposite sides of the ear and directly above those previously removed. Then from near the middle of the ear remove two kernels from opposite side of the ear but at right angles with the kernels already removed. These six kernels are to be placed with the germ up in the square having the same number as that on the ear. Proceed in this manner until all the ears have had samples taken for the test. Then cover the kernels with two thicknesses of canton flannel. Sprinkle with water and cover the box with a piece of glass. Ordinarily no more water will be needed. But if so it should be simply sprinkled over the upper piece of cloth. At the end of six days examine the

kernels by carefully removing the upper cloth. Ears whose kernels have not given a good strong sprout should be discarded. If any ears must be discarded select others to take their places and proceed to test their vitality.

### SHELLING CORN FOR PLANTING.

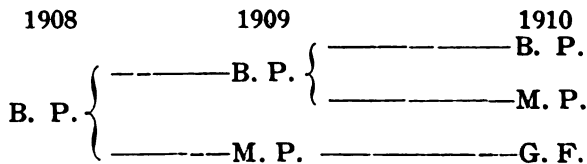
To secure the corn from the breeding ears for planting first discard the tip and butt kernels. Then remove all the balance of the corn with the exception of two adjacent rows which are to be left as a means of telling at any time the character of the ear and its kernels. This ear should be tagged with a number so that it may be told at any time. These samples should be stored where they will not be injured. The corn should be placed in a paper sack until wanted for planting, so that there is no danger of mixing it with the corn from other ears.

### BREEDING PLOT.

This should be the best and most uniform piece of ground on your farm, and be isolated to prevent the pollination of any of the silks by foreign pollen. The other details as to planting and care of the breeding plots have already been described.

### MULTIPLYING PLOT.

After selecting the breeding ears for the next year all the remaining good ears should be saved to be planted in the multiplying plot. Place this plot where no foreign pollen can reach it. The corn from this field is to be selected and planted the following year in the general field as follows:



In this diagram B. P. stands for the breeding plot, M. P. for the multiplying plot, and G. F. for the general field.

## THE FUTURE OF CORN BREEDING IN ALABAMA.

There is no doubt that corn-breeding will in the near future occupy much more attention at the hands of Alabama farmers than at present. To the man who engages in it now with the determination to produce the best type of corn possible this field of work offers good returns on the time and money invested. Not only will the individual corn-breeder secure higher yields, but there is a fine chance to dispose of high-grade seed corn when it is backed by good honest work and detailed records as to pedigree. The time is coming when more and more people will demand seed corn on the ear and from fields that have given high yields. We should be glad to enter into correspondence with all persons interested in this line of work, and stand ready to offer the best suggestions we have on the subject.

### LITERATURE OF CORN BREEDING.

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1907. Type and variability of Indian corn. Bull. Ill. Exp. Stat. 119:1-29.

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 1907. The improvement of corn. Bull. Va. Exp. Stat. 165.

#### EXPLANATION OF PLATES.

- Plate 1. Individuality of the ear as shown by differences in height of the stalk during the season. Note particularly the low row in the center of the field.
- Plate 2. Funk's Yellow Dent corn grown by Funk Brothers of Bloomington, Illinois. Note the great uniformity of the ears.
- Plates 3 to 7. inclusive. Showing the ears in the ancestry of the ten best ears grown in the breeding plot during 1907. The ears marked with numbers in five hundred were grown in 1905, those marked in six hundreds were grown in 1906, and those marked in seven hundreds were grown in 1907. Ear 702 was from row 42 of 1907, and this in turn from row 37 of 1906. Each horizontal series of three ears is similarly related.

PLATE I.

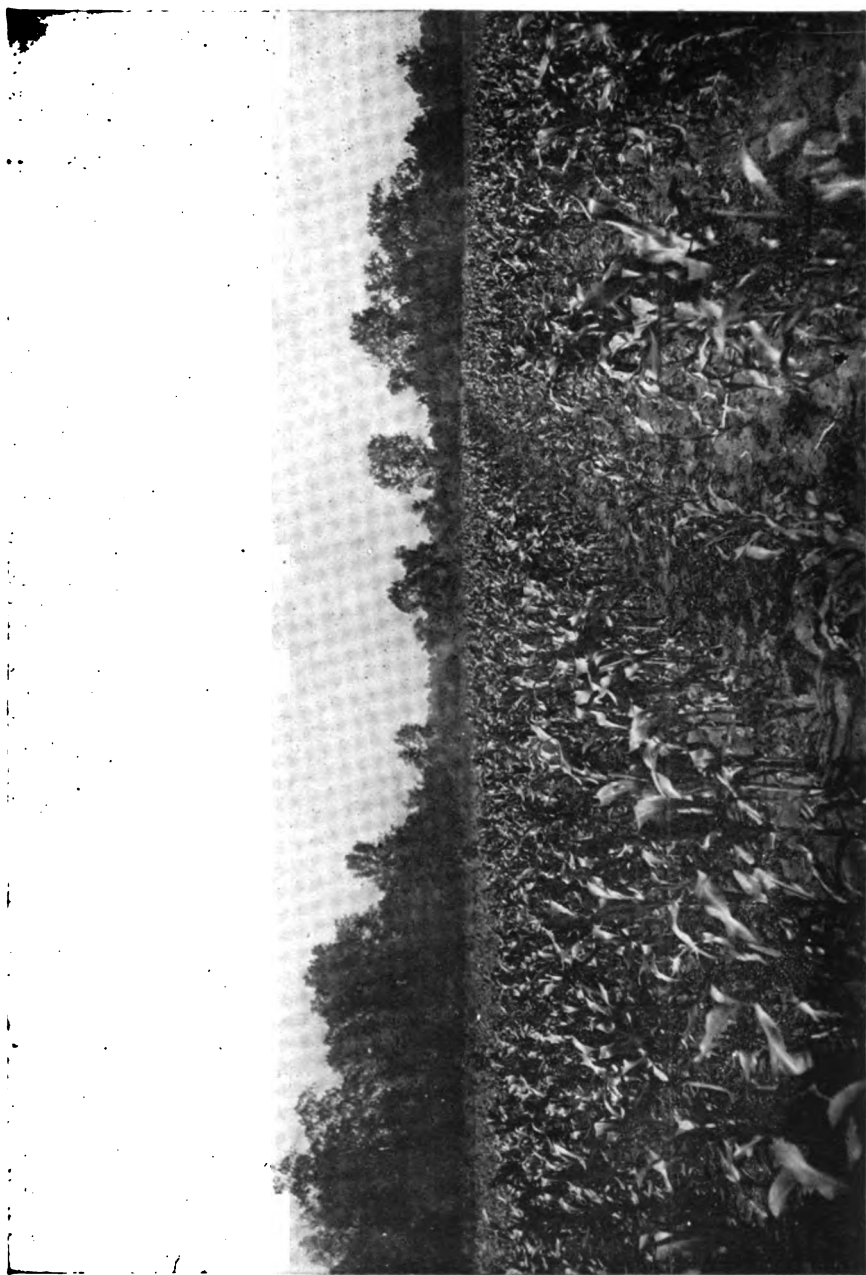


PLATE II.

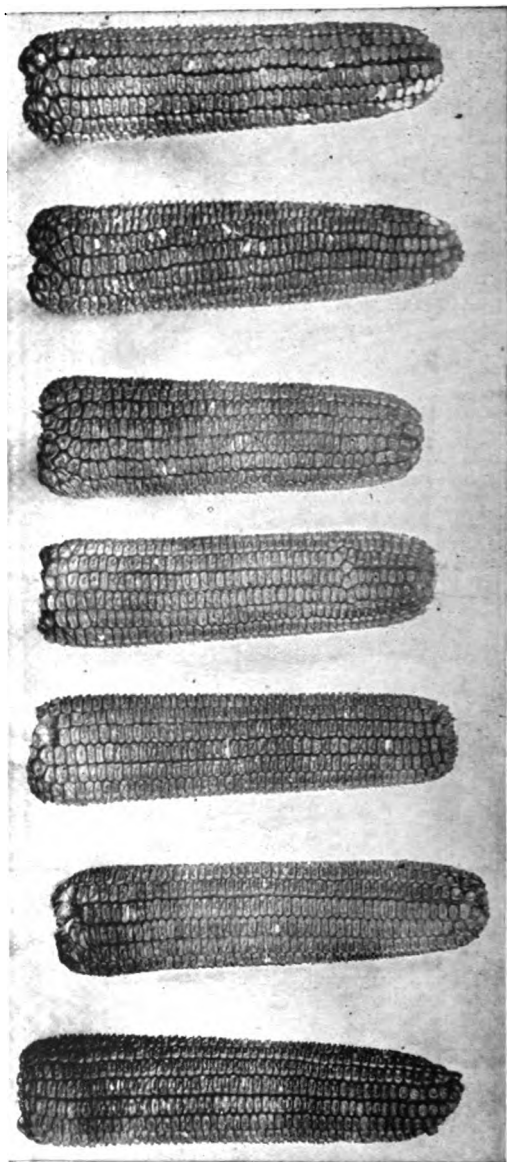
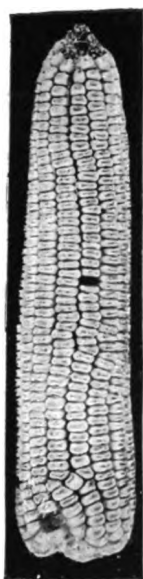


PLATE III.



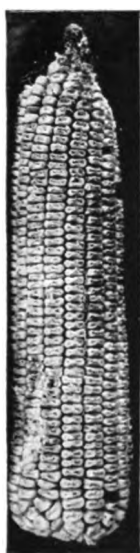
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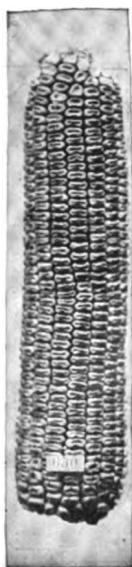
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702



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650

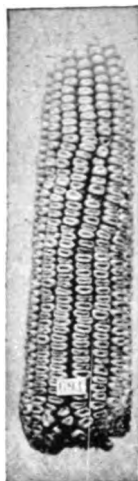


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**PLATE IV.**



**539**



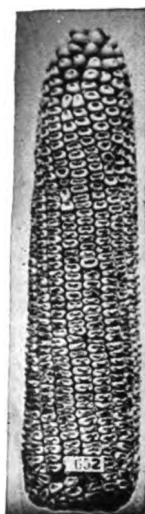
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**522**

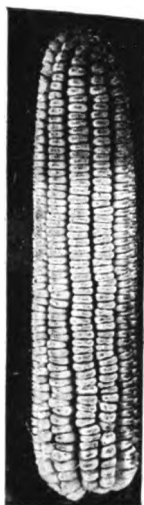


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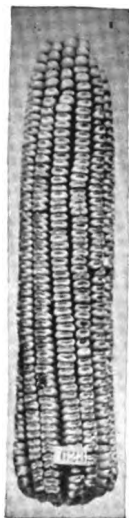


**788**

PLATE V.



535



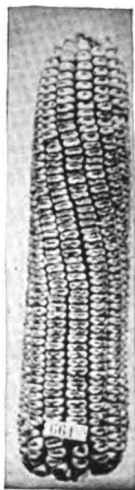
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730



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661



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PLATE VI.



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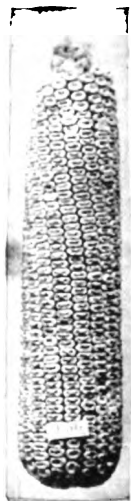
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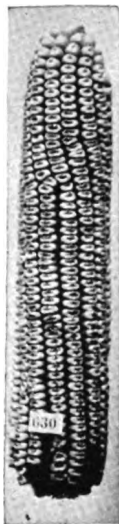


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PLATE VII.



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634



745





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**BULLETIN NO. 143**

**JULY, 1908**

**ALABAMA**

**Agricultural Experiment Station**

**OF THE**

**Alabama Polytechnic Institute**

**AUBURN**

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**Feeds Supplementary to Corn For Southern**

**Pork Production**

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**BY**

**DAN T. GRAY, J. F. DUGGAR, J. W. RIDEGWAY**

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## FEEDS SUPPLEMENTARY TO CORN FOR SOUTHERN PORK PRODUCTION.

By

D. T. GRAY, J. F. DUGGAR, J. W. RIDGEWAY.

### SUMMARY.

1. This bulletin records a summary of three years' work in swine production, in which 90 hogs have been used.

2. The object in presenting this bulletin is to get together the three years' work so as to make a comparison between finishing hogs upon corn alone and finishing them upon corn supplemented with either green crops or concentrates.

3. When corn was used alone as a ration for fattening hogs both the daily gains and the financial outcome were unsatisfactory. Money was lost in every case where corn was fed without a supplement.

4. When corn was supplemented with a partial ration of cotton seed meal the daily gains and the financial outcome were satisfactory. Four deaths occurred as a result of the use of cotton seed meal, *but these deaths did not occur while the animals were eating the meal. All of the deaths have occurred soon after the animals were taken off of cotton seed meal and placed upon a ration which contained no cotton seed meal.* This suggests the idea that cotton seed meal may be stimulating in its effects—similar to the action of certain drugs—and when it is removed suddenly from the animals that death may occur through depression.

5. Tankage, a packing house by-product, proved to be an exceedingly satisfactory feed to supplement corn. In fact, it was almost as satisfactory as cotton seed meal, and it has the advantage over cotton seed meal in that there is no danger in feeding it.

6. When corn was supplemented with a ration of one-half cowpeas (the seed) the results were more satisfactory than when corn was used alone, valuing the cowpeas at

80 cents per bushel. The peas were used profitably until they reached a price of \$1.05 per bushel.

7. As a whole, peanut pasture was found to be more useful than any other pasture tried. Notwithstanding the fact that the peanut pastures were not good two years out of the three they still gave excellent results. Pork was made at a good profit when peanut pasture was used in conjunction with corn.

8. Mature sorghum pasture has very little to recommend it as a feed for fattening swine. Both the gains and the financial outcome were unsatisfactory.

When the sorghum was cut and carried to the hogs the results were better than when the hogs were made to graze the crop.

9. The expense of extracting the juice from the sorghum and feeding the juice only prohibits its use in this way, although excellent daily gains were made. In no case was the juice found to be worth more than 1.8 cents a gallon as a feed for hogs.

10. Soy bean pasture ranked second to peanut pasture as a supplement to corn.

11. Chufa pasture was not found to be as good as either peanuts or soy bean pasture.

12. The average daily gains were as follows: corn alone, .69 of a pound; corn 2-3 of the ration plus cotton seed meal 1-3, 1.04 pounds; corn 9-10 plus tankage 1-10, 1.04 pounds; corn 1-2 plus cowpeas 1-2, .94 pounds; corn plus peanut pasture, 1.01 pounds; corn plus sorghum pasture, .37 pound; corn 2-3 plus cotton seed meal 1-3 plus peanut pasture, 1.00 pound; corn 2-3 plus cotton seed meal 1-3 plus sorghum pasture, .46 of a pound; corn plus chufa pasture, .72 of a pound; corn plus soy bean pasture, 1.02 pounds; corn 2-3 plus cotton seed meal 1-3 plus soiled (cut sorghum), .75 of a pound.

13. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was not taken into consideration, was as follows: corn alone, \$7.63; corn 2-3 plus cotton seed meal 1-3, \$5.75;

corn 9-10 plus tankage 1-10, \$5.18; corn 1-2 plus cowpeas 1-2, \$5.11; corn plus peanut pasture, \$2.28; corn plus sorghum pasture, \$5.46, corn 2-3 plus cotton seed meal 1-3 plus peanut pasture, \$1.97; corn 2-3 plus cotton seed meal 1-3 plus sorghum pasture, \$4.85; corn plus chufa pasture, \$3.81; corn plus soy bean pasture, \$1.96; corn 2-3 and cotton seed meal 1-3 plus soiled sorghum, \$3.39.

14. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was counted against the gains, was as follows: corn alone, \$7.63; corn 2-3 plus cotton seed meal 1-3, \$5.75; corn 9-10 plus tankage 1-10, \$5.18; corn 1-2 plus cowpeas 1-2, \$5.11; corn plus peanut pasture, \$3.20; corn plus sorghum pasture, \$11.90; corn 2-3 plus cotton seed meal 1-3 plus peanut pasture, \$2.14; corn 2-3 plus cotton seed meal 1-3 plus sorghum pasture, \$7.79; corn plus chufa pasture, \$8.89; corn plus soy bean pasture, \$2.74; corn 2-3 plus cotton seed meal 1-3 plus soiled sorghum, \$4.86.

15. When hogs have been grazing a green crop it usually pays to inclose and feed them in a dry lot for a short period after the crop is exhausted.

16. When corn was fed alone but 48 cents was realized upon each bushel of corn used. The way to secure a better price for the corn is to feed it in combination with some other feed.

17. When hogs sell for from 5 to 7 cents a pound live weight the farmer cannot afford to sell his corn for 70 cents a bushel.

### INTRODUCTORY.

While Alabama produces a portion of the pork that her people consume she falls far short of meeting home demands. Much of the pork we use is made in Illinois, Iowa, Ohio, and other northern states. It costs the farmer as much, and perhaps more, in those states to produce a pound of pork than the same pound would cost if produced by the Alabama farmer; under present conditions our people pay those northern farmers a good profit upon their pork-making operations and in addition, pay heavy freight



rates to get the meat transferred to the South. It is no uncommon sight to see the Alabama farmer hauling to his country home meat killed in Chicago. This meat costs from 10 to 12.5 cents at present prices—and it is a cheap quality of meat at that. The Alabama farmer could have made that pork upon his own farm for about one-half the above expense, and by the judicious use of supplementary feeds, could have the meat for at least one-third of what he must pay for it at the grocer's store. Besides getting the meat cheaper, thus saving his money, he would have upon his table first class hams, ribs, and chops instead of the poorer quality of side meat.

#### OBJECT OF EXPERIMENTS.

These experiments were planned with a three-fold object in view:

1. To compare finishing hogs upon corn alone (the usual method followed in the South) with finishing them upon corn supplemented in some cases with a concentrated feed and in some cases with green crops.

2. To study the efficiency of different feeds, or combinations of feeds, in hardening the flesh of hogs after it has been rendered soft as a result of the animals grazing peanuts.

3. To study the effect of different feeds—with special reference to cotton seed meal—upon the strength, chemical composition, and histology of the bones.

The first object only is dealt with in this bulletin. The other two will receive consideration in a later report.

#### ANIMALS USED.

This report is based upon three years' experimentation and can be considered only as a report of the progress of the work. Ninety hogs have been used during these three years, divided into numerous lots—six lots each year. While definite conclusions could not be drawn from the data collected through the use of so few animals in a single year's work, yet the test has been repeated in many respects the third year, so the conclusion drawn can be

regarded as fairly accurate and trustworthy. The hogs used, while perhaps somewhat better in quality than the average hogs of the state, can be considered about equal to the animals which our best farmers keep upon their farms. They were picked up from neighboring farmers around Auburn, and all of the animals had some improved blood in them. This improved blood consisted largely of Poland-China or Berkshire blood; there were also a few Yorkshire grades. A few of the animals showed close kinship to the "razor backs." At the beginning of the test they averaged something like seventy pounds in weight, and probably averaged five months in age.

#### QUARTERS.

The pigs which were fed upon concentrates only were confined in dry lots which had a good open shed across one end which afforded them protection from both the hot sun and the cold rains. These lots were about 30 by 100 feet in size. The hogs which were running upon a pasture crop were confined upon these crops by means of a moveable fence (or hurdles); these lots were also afforded shelter from the hot sun by means of trees and bushes or by artificial structures. All the pigs in all cases were made comfortable. When the pigs were grazing a green crop, in some cases they were given the run of but a small area at a time, and the hurdles were then moved forward on a new area, but in other instances the whole area was fenced in and the animals given the privilege of running upon the whole area at one time. There is perhaps a smaller waste when but a small area is grazed at a time, but the labor in moving the fence is not inconsiderable if the areas are made too small.

#### DIVISION INTO LOTS.

Each year when the pigs were brought to the Animal Industry farm the whole lot was put under similar conditions a sufficient length of time to establish uniformity, after which time, they were carefully divided into six lots as nearly equal as possible in quality, age, size, weight, sex

and breed with previous condition and raising taken into consideration.

#### FEEDING.

All of the lots were fed twice daily throughout the entire tests, as nearly as possible at the same hour each day, so as to avoid producing restlessness among the pigs. With the exception of the year 1905-'06 the corn was ground and fed in a slop. When the corn was fed with other concentrates the two were always mixed together and fed as a slop. During the years 1905-'06 and 1906-'07 the cotton seed meal was always fermented, or soured, twenty-four hours before feeding, but during the last year, 1907-'08, it was taken directly from the sacks, mixed with the corn meal, and given to the hogs. Those rations which contained cotton seed meal were fed in a very thin slop—in fact so thin that the animals could drink the feed rather than eat it. It was soon learned that when the cotton seed meal was fed in an exceedingly thin slop that the pigs always maintained a keen appetite for the feed, no matter how long they were kept on the feed, but when the ration was placed before them in a dough state it would be but a few days until the whole pen would “go off feed”.

All green crops used by the hogs were gathered by the hogs themselves, except in one case in 1905-'06 where sorghum was cut and carried to one lot confined in a pen in order that a comparison might be made with sorghum grazed and sorghum fed in a dry lot (soiled).

All the lots at all times had a mixture, consisting of salt, coal and lime, before them. It was very noticeable that those pigs upon corn alone ate much more of this mixture than did the other lots.

The quantity of food given those pigs which were confined in the lots was gauged by their appetites, the object being to give each lot all it would eat up clean and still retain the appetite. The lots which received a green ration in addition to the grain were not given a full grain ration. Such lots received a grain ration equal to two per cent of the total live weight of the lot; for instance, if

a certain lot weighed 800 pounds the daily grain ration would have been 16 pounds. Thus the lots on pasture crops received what may be considered about half a full ration of concentrated food.

#### THE PASTURE CROPS.

The sorghum crops were as good each year as they could be expected to be when grown upon poor sandy soils. The sorghum was grown in drills and cultivated. The yields, green weight, averaged about eight tons to the acre. The hogs were turned upon the pasture just about the time the juice began to sweeten—or about the time the heads began to turn black, when the sorghum plants were usually 5 or 6 feet high. It was hard work for the hogs to graze the sorghum as the juice was secured so slowly by them that they were never satisfied; so they put in practically all their time riding down the stalks and chewing the cane; this is not conducive to rapid and economical gains. The peanut crops were not as good as the sorghum crops. In 1905-'06 there was practically a full stand and yield of peanuts. In 1906-'07 there was a very poor stand and not more than a 40 percent yield. In 1907-'08 the yield and stands were even poorer than the previous year. The poor stands and yields were largely due to the fact that labor could not be secured to work the crops after they were put in.

The chufa crop was an average crop, and the soy bean stand was not far below the average, but the yield was cut down somewhat on account of the extremely dry weather just at the time the beans were maturing, so that they finally yielded about 70 per cent of a normal crop. The hogs were turned upon the soy beans two weeks before the beans were matured enough to be eaten, so for the first two weeks the animals ate nothing but the leaves in addition to the corn they received; the records show that the animals made satisfactory gains even these first two weeks.

#### PERIODS.

Each year's work was divided into periods because the

nature of the work required that it be thus divided, as one of the main points was to study the effect which different feeds might have upon the melting point of the lard when following other feeds, as peanuts. The first year's test, 1905-'06, was divided into two periods. The two following years' work were divided into three periods each. Each period varied in length from twenty-eight to fifty days, thus making each full experiment from ninety to one hundred and ten days in length.

#### SLAUGHTER DATA.

At the end of each period one animal from each lot was slaughtered and careful notes collected upon the dressed weights, appearance of the carcasses, the rapidity and the extent of the "setting", the appearance and weights of the internal organs, etc. Samples of fat were taken from each carcass and turned over to the chemist, Professor Hare, who made melting point determinations, and further studies to learn the effect of different feeds upon the fat of swine. The fifth, sixth, and seventh ribs were also taken from each animal slaughtered with a view to making a chemical and histological study of the effect of the various feeds upon the animal frame work.

#### SALES.

The animals were all sold to either the Auburn or Opelika butchers at five cents per pound live weight. If they could have been placed upon the Montgomery or New Orleans market they would have brought from six to seven and one-half cents per pound live weight. The majority of the pigs at the beginning of the test were purchased at a cost of five cents per pound, so under local conditions there was no margin of profit between the buying and the selling prices.

#### VALUES PLACED UPON FEEDS.

In working out the financial statement which follows, the following values were placed upon the feeds:

Corn .....	70 cts. per bushel,
Cowpeas .....	80 cts. per bushel,
Cotton Seed Meal .....	25 dollars per ton,
Tankage .....	40 dollars per ton.

As a rule there has been no expense charged against the gains made by the hogs as a result of putting in and working the green crops. This varies so much in different localities that figures would be of very little value. But to give an approximation of what it would cost to make a pound of pork when the crops are charged against the animals the cost has been worked out for the conditions existing here upon the station farm (see table 17 page 61). It has been considered, in this bulletin, that the cost of putting in and cultivating the crop was offset by the good done the soil by having the pigs graze over it and drop the manure. This is not merely an assumption; it has been experimentally proven that where hogs on a partial ration of concentrates have been permitted to graze over an acre of green crops, that the increase yield in the cotton crop following the next year alone was 195 pounds of seed cotton, and the second year's increase, due to the grazing two years before, was 183 pounds of seed cotton.

#### DISCUSSION OF THE EXPERIMENT.

The feeding tests here reported were conducted at different times throughout the year 1905-'06, 1906-'07, 1907-'08. With the exception of the first year the general plan was to begin the work in August or the first part of September and carry some of the lots from 35 to 50 days upon various concentrated feeds and the other lots on sorghum, as sorghum comes on earlier in the summer than do the peanuts. During the year 1907-'08 both soy beans and sorghum were used as green crops during the first period. After the first period the peanuts were ready to use and the lots were transferred from the sorghum and the soy bean pastures to the peanut pasture. The peanut pasture was exhausted in from 28 to 35 days, after which time the lots were all brought in and fed in dry lots upon concentrates only, for a finishing period of 28 days. The following tabulated statement displays the plan of the work:

TABLE 1. *General Outline of the Experiments.*

1905-6			
No. Lot	RATION AND DATE		
	Period 1,	Period 2 (60 days) Sept. 21-Nov. 10	Period 3 (35 days) Nov. 10-Dec. 15
1		Peanut pasture Corn	Corn only
2		Peanut pasture Corn	Corn 2-3 C. S. Meal 1-3
3		Peanut pasture Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
4		Sorghum juice Cowpeas 2-3 Corn 1-3	Sorghum Juice Cowpeas 1-3 Corn 2-3
5		Cowpeas 2-3 Corn 1-3	Cowpeas 1-3 Corn 2-3
6		Corn only	Corn only
1906-7			
	Period 1 (49 days) Aug. 8-Sept. 26	Period 2 (28 days) Sept. 26-Oct. 24	Period 3 (35 days) Oct. 24-Nov. 28
1	Cut sorghum Corn 2-3 C. S. Meal 1-3	Peanut pasture, Corn	Corn only
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
4	Sorghum juice Corn 2-3 C. S. Meal 1-3	Chufa pasture Corn	Japan cane Corn 2-3 C. S. Meal 1-3
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only
1907-8			
	Period 1 (35 days) Sept. 6-Oct. 11	Period 2 (28 days) Oct. 11-Nov. 8	Period 3 (28 days) Nov. 8-Dec. 6
1	Soy bean pasture Corn	Peanut pasture, corn Corn	Corn 2-3 Tankage 1-3
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Grazed sorghum Corn	" " "	Corn
4	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only

## PEANUT PASTURE TO SUPPLEMENT CORN.

In all cases where peanuts were used the hogs were grazed upon them, thus saving the expense of having them harvested. This method of harvesting a crop has the additional advantage of having the manure scattered upon the cultivated fields just where wanted without the expense of hauling it with wagon and team. The data in this bulletin covers three years' work with peanuts but the first year's work is the only one during which time there was an average crops of nuts, as noted elsewhere; the crops of both the years 1906-'07 and 1907-'08 were very poor ones due to the fact that labor could not be secured to work them.

TABLE 2. *Summary of the three years' work with Peanuts.*

Ration	No. Animals Used	Average Daily Gains	Initial weight of pigs	Grain required for 100 lbs. gain	Cost of grain for 100 lbs. gain
Corn alone .....	15	Lbs. .69	73	Lbs. 611	\$7.43
Corn .....				148 Corn	
Peanut pasture...	32	1.01	81	.45 acre peanuts	1.85

This table, while illustrating the great use to which peanut pasture can be put in saving corn, does not deal fairly with the nuts as far as the area which is required to produce 100 pounds is concerned; as noted above, the nuts were not a full crop two of the years. Usually the area required to produce 100 pounds gain will be cut down very materially from that shown in the above table, as may be seen in a following table, in which case the peanuts were practically a full crop—or an average crop. Even though in two years out of the three there were poor stands, still the nuts made a good showing. The table indicates that .45 of an acre of peanuts was equal in feeding value to 463 pounds of corn, and that the cost of concentrates



required in making 100 pounds gain was reduced from \$7.63 in the case of corn alone to \$1.85 when the corn was supplemented with peanuts. In this table there has been no expense counted against the animals as a result of putting in and cultivating the green crops, as it has been experimentally proven that when a leguminous crop, like peanuts, is grown and grazed off by pigs, that the increased fertility, as measured by the succeeding year's crop of cotton, has sometimes more than paid for the expense of putting in the crop. (See page 74).

Money was lost in the case where corn alone was fed to pigs, the gains costing \$7.63 per 100 pounds and could be sold for but \$5.00 per 100 pounds at Auburn. Seventy cent corn calls for seven-cent hogs, live weight, if the feeder expects to come out even and realize 70 cents a bushel for corn.

The daily gains were much more satisfactory where the peanuts were grazed than when corn alone was fed. Hogs are never satisfied when fed corn alone. Corn alone does not meet the body requirements; it is lacking in protein and ash, so that when a young animal is compelled to eat corn alone he soon fails to make satisfactory gains, becomes restless, and puts in much of his time in rooting about the pen and trying to get out. A peanut-fed hog is always contented, as this feed meets the body requirements and he spends his spare time sleeping.

Bone samples have been saved from all of the animals and casual observation shows the bones of hogs which have been fed on corn alone to be much weaker and smaller than in the case where the corn was supplemented with other feeds.

During the year 1905-'06, in addition to having a peanut lot upon corn alone, there was another peanut lot which received, in addition to the peanut pasture, a two percent ration of corn and cotton seed meal, in the proportion of two-thirds corn and one-third cotton seed meal.

TABLE 3. *Corn versus Corn and Peanuts, versus Corn 2-3 plus Cotton Seed Meal 1-3.*

Ration	No. Animals used	Average Daily Gains	Initial weight of pigs	Feed required per 100 lbs. gain	Cost of grain for 100 lbs. gain
Corn alone.....	4	<i>Lbs.</i> .67	<i>Lbs.</i> 65	<i>Lbs.</i> 560	\$7.00
Corn .....				177	
Peanut pasture....	8	.91	60	.12	Corn peanuts 2.22
Corn 2-3, .....				107	
C. S. Meal 1-3.....	4	1.00		51	C. S. Meal
Peanut pasture....			59	.08	acre peanuts 1.97

This is the year's work when there was a normal crop of peanuts and represents more accurately what can be expected from the use of peanuts than does the preceding table. All of the lots, even the corn lots, made very satisfactory gains for such small animals. The lot upon peanuts, with corn alone added, made 35.8 per cent better gains than did the lot upon corn alone, and when both corn and cotton seed meal were added to the peanuts the gains were 47.7 per cent better than that of the corn lot. The daily gains were increased by 35.8 and 47.7 per cent respectively through the addition of peanut pasture or of peanut pasture and cotton seed meal to corn alone and at the same time the cost of producing 100 pounds of pork was decreased from \$7.00 in the case of corn alone to \$2.22 when corn and peanut pasture were used, and to \$1.97 when both corn and cotton seed meal were used in connection with the peanut pasture.

This table also illustrates the fact that when corn is worth 70 cents per bushel a farmer must secure 7 cents per pound, live weight, for his hogs if he expects to come out even when corn alone is fed.

When some cotton seed meal was added to the corn rations of the hogs when running on peanuts, the daily

gains were increased and the cost of one hundred gain was reduced from \$2.22 to \$1.97. No ill results followed the use of the cotton seed meal, but that is not a guarantee that evil results will never follow its use.

Tankage can be used to take the place of cotton seed meal when the farmer is afraid of losses from the use of cotton seed meal (as will be seen later), but tankage was found to be somewhat inferior to cotton seed meal for pork production.

Where corn alone was fed in addition to peanut pasture it was found that .12 of an acre of peanuts took the place of 382.5 pounds of corn, or one acre of peanuts was equal in feeding value to 56.9 bushels of corn. When both corn and cotton seed meal were fed in addition to peanut pasture one acre of peanuts was still more valuable than when corn alone was used. If the land upon which these peanuts were grown had been planted in corn instead of in peanuts it would have perhaps produced only fifteen to eighteen bushels of corn to the acre.

#### SORGHUM.

Sorghum is a green crop well thought of in the South as a food for swine. Its chief advantage lies in the large yields and sureness, there being very few seasons in which it fails. But it must be remembered in planning a rotation of crops that sorghum is not a legume, and that the land will not be made better on account of its having been grown. Other things being equal, a leguminous crop should generally be grown for a hog feed, on account of its beneficial effects upon the soil. This bulletin comprises two years' work with sorghum. In some cases the grain fed in connection with the sorghum consisted of corn alone, in other cases of a ration made up of corn two-thirds and cotton seed meal one-third. Only a half grain ration was fed.

In all cases the hogs were not turned into the sorghum field until the juice began to sweeten, or until some of the heads began to turn black.

A test was also made to determine whether it would be

profitable to cut the sorghum in the fields and carry it to the hogs when confined in pens.

TABLE 4. *Corn alone versus Corn and grazed Sorghum;  
Corn alone versus Corn 2-3 Cotton Seed Meal, 1-3  
and grazed Sorghum*

Ration	No. Animals used	Average Daily Gains		Initial weight of pigs	Feed required for 100 lbs. gain	Cost of grain per 100 lbs. gain
		Lbs.	Lbs.			
Corn alone.....	6	.78	73	456		\$5.70
Corn .....				437	Corn	
Grazed sorghum	6	.37	73	.57	acre sorghum	5.46
Corn 2-3 .....				206	Corn	
C. S. Meal 1-3..				103	C. S. Meal	
Grazed sorghum	6	.51	74	.37	acre sorghum	3.86

While the pigs which were confined in dry lots and fed corn alone made much better gains than can usually be expected from the use of corn alone, those animals which received the half ration of corn plus sorghum pasture, made a very poor showing, the daily gain being but .37 of a pound per pig. Another lot of pigs, not mentioned in table 4, but treated similarly to the sorghum lot, with the exception that they had soy beans in the place of sorghum, made an average daily gain of 1.02 pounds.

In the case above it is seen that .57 of an acre of sorghum took the place of but 19 pounds of corn, which means that one acre of sorghum saved but 32 pounds of corn when the sorghum was supplemented by corn alone.

A feed consisting of corn and sorghum alone is a very poor feed for either fattening hogs, or for producing growth. Both are low in protein and ash and high in carbohydrates, neither feed furnishing enough protein or ash for hogs which are not completely matured before the finishing period begins. The sorghum might have made a

better showing if the pigs used had been matured animals before the fattening period began.

When the ration of corn and sorghum was supplemented with a little cotton seed meal, as was the case with lot 3, the results were more satisfactory, but even with the use of cotton seed meal the results do not compare favorably with the results gotten from the use of either peanut or soy bean pasture as a supplement to corn. With the use of both corn and cotton seed meal 309 pounds of concentrates were required to make 100 pounds of gain, at a cost of \$3.86. Data will be presented later on in the bulletin showing .37 of an acre of sorghum in lot three saved grain to the value of only \$.56, or an acre of sorghum saved, in terms of concentrates, but \$1.57.

In view of the fact that it is very hard work for pigs to graze sorghum, as the cane must be ridden down, and as it requires all of the hog's time—and more, too—to satisfy his appetite, since the juice is secured very slowly, it was thought that it might be profitable to place the hogs in a pen and carry the sorghum to them (soiling). According to this test was tried in 1906-'07 with the following results:

TABLE 5. *Grazing Sorghum versus soiling Sorghum.*

Ration	No. Animals used	Average Daily Gains	Average Initial weight of pigs	Feed required per 100 lbs. gain	Cost of concentrates per 100 lbs. gain
Corn 2-3 .....	5	Lbs. 1.18	Lbs. 85	Lbs. 212 Corn	\$3.99
C. S. Meal 1-3....				106 C. S. Meal	
Corn 2-3 .....	5	.43	90	314 Corn	5.90
C. S. Meal 1-3... Grazed sorghum				157 C. S. Meal .15 acre sorghum	
Corn 2-3 .....	5	.75	82	181 Corn	3.39
C. S. Meal 1-3... Soiled sorghum				90 C. S. Meal .13 acre sorghum	

Where a combination of corn and cotton seed meal was fed rapid and economical gains were made; this was inva-

riably the case in these experiments no matter under what conditions fed.' When cotton seed meal is fed properly the hog will either make rapid gains or die. As stated elsewhere there have been no deaths during these series of tests where the hogs received a large ration of cotton seed meal, but this is no guarantee that deaths may not occur next year.

The hogs (lot 2) which grazed the sorghum down made a poor showing,—in fact the sorghum was a detriment instead of a help in this case. Where the hogs had the sorghum carried to them, (lot 3) the data show that .13 of an acre saved but \$.60, or a whole acre of green sorghum after being cut and hauled to the hogs was worth but \$4.61.

Under the conditions in which sorghum was fed in these experiments it was found to be almost worthless as a supplement to either corn or to a mixed ration of corn and cotton seed meal. It would no doubt be more valuable when fed to larger hogs than were used here. As used in these tests it was not found to be adapted to hogs which were being fattened. Probably one of the chief reasons why it is not a profitable hog feed is that it requires too much work on the part of the hog to extract the juice, and this work prevents the hog from laying on fat. A hog receiving only a two-per-cent grain ration and green sorghum is never satisfied; he always wants to get out of the inclosure, and when he is not trying to get out he is either chewing the cane or rooting in the ground.

Sorghum has probably one valuable place as a hog feed—to help carry the brood sows through the summer months economically when the pastures become short. Sorghum is a bulky feed and is more suited to ruminants—animals with a system of stomachs, as that of the cow and the sheep—than to the hog. The hog makes no use of the leaves and the fibrous part of the stalk at all; his stomach is too small for such bulky roughage. He eats the juice only, and much of that even is lost while he is chewing the stalk.

It should be remembered that this bulletin reports no sorghum experiments in which the plant was grazed when young; in every case the sorghum was far enough advanced so that the juice was sweet to the taste. Some farmers report success with the plant when the hogs are turned into the field when it is about one foot in height, thus inducing them to eat the tender blades along with the immature juice.

#### SOY BEANS.

Soy beans is another leguminous crop which has proven very satisfactory as a green crop with which to supplement corn in pork production. The hogs in this experiment were turned into the field two weeks before the beans were matured sufficiently to be eaten so that for the first two weeks the swine had only the leaves and the stalks to eat, in addition to the two per cent corn ration. The hogs did not touch the beans themselves for about fifteen days after being turned into the patch. The leaves, both dead and green ones, were eaten with relish. It might have paid better to have kept the hogs off the beans until the seed were ripened sufficiently to be eaten,—that is a point open for further experimentation.

TABLE 6. *Soy bean pasture as a supplement to Corn.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required per 100 lbs. gain	Cost of Concentrate per 100 lbs. gain
Corn alone .....	6	Lbs. .78	Lbs. 73	Lbs. 456	\$5.70
Corn .....				157 Corn	
Soy bean pasture	6	1 02	77	.28 acres soy beans	1.96

Considering the beginning weights of the pigs, both lots made good gains, but the gains of the soy bean lot were much better than those of the corn lot. Running right by the side of the soy bean lot was a lot of pigs which were grazing sorghum, but otherwise treated the same in every

respect, yet the sorghum lot made a daily gain of only .37 of a pound.

The corn required to make an hundred pounds gain was reduced from 456 pounds in the case of corn alone to 157 pounds when the corn was supplemented by the soy bean pasture, and the cost of producing the pork was reduced in the same proportion.

It was noticed that the pigs which grazed upon the soy beans were always contented; they spent the greater part of their time in lying down. The pigs just across the fence, which were grazing the sorghum, were never contented or at rest; it could plainly be seen that they wanted something in addition to the corn and sorghum.

The above table shows that .28 of an acre of soy beans was equal to 299 pounds of corn, or an acre was equal in feeding value to, or capable of taking the place of, 19.1 bushels of corn. As noted elsewhere, the crop of soy beans was not a good one, as the beans were cut short on account of extreme drought at the time of maturing. This crop is a very economical and easy one to put in and cultivate; it is good to use it as a catch crop after oats, thus saving the ground from lying idle during the summer months, and at the same time securing a crop equal to, and in many ways superior to a corn crop. In this way, the farmer secures two crops from the same land each year, cheapens pork production very greatly, and builds up the fertility of his soil rapidly. If the soil be good much better results can be secured than reported above, as the soil upon which this crop was grown was a poor sandy one.



TABLE 7. *Sorghum pasture versus Soy Bean pasture.*

Ration	No. Animals Used	Average Initial Weight of Pigs			Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Average Daily Gains	Lbs.	Lbs.		
Corn .....	6	Lbs.	Lbs.	Lbs.	437 Corn .57 acre sorghum	\$5.46
Sorghum past'r		.37	73			
Corn .....	6			157 Corn	.28 acre soy beans	1.96
Soy bean past'r		1.02	77			

The soy bean pasture is far above the sorghum pasture both in the daily gains made and also to the economy of the gains. The daily gains were about three times as rapid when the bean pasture was used as when the sorghum pasture was used, and the cost of making one hundred pounds of gain was reduced from \$5.46 in the case of sorghum to \$1.96 when soy beans were used as a supplementary pasture.

The soy bean pasture also had a much greater carrying capacity than did sorghum pasture; that is an acre of soy beans will usually carry a certain number of hogs a much longer time than will an acre of sorghum.

#### COWPEAS (SEED) AS FOOD FOR HOGS.

TABLE 8. *Corn alone versus Corn 1-2 plus Cowpeas 1-2.*

Ration	No. Animals Used	Average Initial Weight of Pigs			Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Average Daily Gains	Lbs.	Lbs.		
Corn alone .....	4	Lbs.	Lbs.	Lbs.	478 Corn 187 Corn 208 Cowpeas	\$5.97
Corn 1-2 .....		.74	63			
Cowpeas 1-2 .....	4	.93	67			5.11

Under the conditions as they existed in this test it was a profitable thing to supplement corn with cowpeas. Estimating cowpeas at 80 cents a bushel there was a saving of 86 cents for each hundred pounds of pork made through the use of the cowpeas.

Peas at the present writing (July, 1908) are not as cheap as they were in 1905-'06. Under the test as above reported peas would have been a profitable supplement to have added to the corn ration until they reached \$1.05 per bushel, and then it would have been better to have fed corn alone at \$.70 a bushel. When cowpeas are maintained at a high price they must be fed more sparingly than they were in this experiment.

In some previous work done at this Station\* in testing the value of cowpeas as a feed for swine, one lot of hogs was fed upon a ration consisting of cowpeas alone. It was learned that when corn and cowpeas were fed separately and alone that they were practically equal in feeding value, but that when a ration was composed of one-half corn and one-half cowpeas the result due to feeding this mixture was much more satisfactory than when feeding either alone. The results were as follows:

TABLE 9. *Corn and Cowpeas separately versus Corn 1-2 plus Cowpeas 1-2.*

Ration	Average Daily Gains	Feed Required Per 100 lbs. Gain	Cost Per 100 lbs. Gain
	Lbs.	Lbs.	
Corn alone .....	.46	487	\$6.09
Cowpeas alone .....	.59	481	6.41
Corn 1-2, Cowpeas 1-2 .....	.62	433	5.60
Corn 1-2, Wheat brand** .....	.60	521	7.05

\*Bulletin No. 82, 1897.

\*\*Wheat bran valued at \$30.00 per ton.

This table also points out the fact that cowpeas were very much more efficient than wheat bran as a feed for swine.

#### TANKAGE.

While tankage has not been used very extensively in the South as a hog feed, still it deserves a prominent place among the concentrated feeds which are usually brought to the feed pens from sources outside the farm. It is a by-product of the packing houses. It is very high in both ash and protein—just the two constituents in which corn is deficient—so it is an exceptionally good feed to use in conjunction with corn. It is somewhat similar to cotton seed meal in composition but has the advantage over cotton seed meal in that there is no danger in its use as a hog feed. It is a very rich feed, so should be used sparingly; in these tests it made up but one-tenth of the whole ration as a rule. The results secured through its use are tabulated below:

TABLE 10. *Corn alone versus Corn 9-10, Tankage 1-10.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
Corn alone .....	6	Lbs. .60	Lbs. 73	Lbs. 574.7 Corn	\$7.18
Corn 9-10 .....	6	1.04	69	352 Corn	5.18
Tankage 1-10....				39.2 Tankage	

The tankage and corn meal were fed together as a rather thin slop. This feed is very palatable. When corn was reinforced by the use of tankage it was found, under the conditions as they existed in this test, that 39.2 pounds of tankage were equal to, or took the place of, 222 pounds of corn. The 39.2 pounds of tankage cost \$.78; the 222 pounds of corn cost \$2.78; thus a saving of \$2 was realized upon

each 100 pounds of pork produced by adding tankage to corn.

The test was carried on for 91 days, and it was noticed that those pigs which received corn alone made smaller and smaller gains as the experiment progressed, but the animals which received the tankage in addition to the corn made larger and larger gains as the time went on.

The corn lots would have tired of their ration long before they did had it not been for the fact that they always had all the salt, coal and lime before them that they wished to make use of.

It was thought that if the proportion of tankage were increased to more than one-tenth of the ration that enough corn might be saved to make up for the extra tankage used. This was tried in a short test where all the conditions of previous feeding favored the lot on the high proportion of tankage; that is, the lot of pigs which received the high tankage ration had just been taken off of a peanut pasture, which insured very rapid gains for at least a short time, while the lot which received the one-tenth ration of tankage had not been upon a pasture at all, but had been fed a uniform dry ration since the beginning of the test.

TABLE 11. *A one-tenth ration of Tankage versus a one-fifth ration of Tankage.*

Ration	No. Pigs Used	Average Initial Weight of Pigs	Average Daily Gains	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
Corn 9-10 .....	4	Lbs.	Lbs.	Lbs.	\$5.01
Tankage 1-10 .....		1.26	120	350 Corn 31.9 Tankage	
Corn 4-5 .....	4			274 Corn	4.77
Tankage 1-5 .....		1.83	142	67.3 Tankage	

By the addition of 35.4 pounds of tankage to the ration

for each hundred pounds gain a saving of 76 pounds of corn was secured. This additional tankage cost \$.71 and the value of the corn saved as a result of the addition of the tankage amounted to \$.96—or a saving of \$.24 on each one hundred pounds of the pork was realized. But it must be remembered that the previous management of the hogs placed the heavy tankage lot at an advantage,—how much, it is impossible to say.

As tankage is a comparatively new feed to the Alabama farmer it is appropriate to present the following table, so there can be seen at a glance its composition as compared to our more common feeds:

TABLE 12. *Average composition of some common feeds.*

Name of Feed	Dry Matter in 100 lbs.	Digestible Nutrient in 100 lbs.		
		Protein	Carbohy- drates	Ether Extract
Corn .....	93.0	31.7	15.3	4.3
Cowpeas .....	91.8	37.2	16.9	1.1
Oats .....	89.0	9.2	47.3	4.2
Cotton seed meal .....	85.2	18.3	54.2	12.2
Tankage .....	89.4	7.8	66.7	13.6

#### COTTON SEED MEAL.

The deaths that sometimes occur through feeding cotton seed meal deter the majority of farmers from using it as a feed for swine. There is no Southern feed to compare with it as a supplement to corn so far as fattening and finishing is concerned. But there is a risk to run, and the man who feeds it has this risk to shoulder. During the last three years this Station has had about fifty hogs upon cotton seed meal rations fed in various proportion with corn, and extending over periods from 28 to 188 days in length. Some of the meal has been fermented and some of it has been fed unfermented. During the first two years above reported the meal was fermented twenty four hours

before being fed, then mixed with corn meal so as to make a thin slop of about the consistency of thick butter milk and given to the animals. The meal was fed sweet in 1907'08. No pigs were lost at all during the first and the last year's experimentation, but during the progress of the second year's work several pigs died that had previously been fed on fermented cotton seed meal. However, during the three years' work not a pig died *while he was actually eating* the cotton seed meal; the deaths occurred immediately, or within a few days, after a lot of pigs which had been upon a ration of two-thirds corn and one-third cotton seed meal plus sorghum pasture, had been taken out and put upon a peanut pasture plus a corn ration only. That is, the deaths occurred—four of them—from one to eight days after the *cotton seed meal ration had been discontinued*. The animals all died with the characteristic symptoms of cotton seed meal poisoning.

Aside from the deaths that may occur, cotton seed meal is a good feed, as will be shown later. It has even now one safe place at least in our swine feeding operations, namely, to be used in a short finishing period when hogs have been taken off of a pasture crop. The following table presents in a tabulated form the average of two year's work with cotton seed meal when both the corn lot and the cotton seed meal lot were fed without any pasture crop.

TABLE 13. *Corn alone versus Corn 2-3, Cotton Seed Meal 1-3*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs Gain
Corn alone .....	11	Lbs. .65	Lbs. 78.5	Lbs. 590	\$7 38
Corn 2-3 .....				303 Corn	
C. S. Meal 1-3.....	11	1 00	77.	157 C. S. Meal	5.75

Not a pig in this particular experiment died while being fed either fresh or fermented cotton seed meal; on the other hand they made good gains, maintained their health throughout, and always had keen appetites for the next feed. Considering the size of the pigs the gains were very satisfactory when the cotton seed meal was used, and the increase in weight was made very much more economically than was the case in the corn lot. The tests show that 151 pounds of cotton seed meal are equal to, or took the place of, 287 pounds of corn; or one pound of cotton seed meal when fed in combination with corn meal in the above proportion was equal to 1.9 pounds of corn. When fed thus the cotton seed meal becomes a highly valuable and cheap feed—provided no deaths occur as a result of its use.

The above tests extended over a period of 102 days.

TABLE 14. *Corn alone versus Corn 1-3 plus Cotton Seed Meal 1-3 versus Corn 9-10 plus Tankage 1-10*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
Corn alone .....	6	Lbs. .60	Lbs. 73	Lbs. 574.4 Corn	\$7.18
Corn 2-3 .....				263.8 Corn	
C. S. Meal 1-3 .....	6	1.03	69	131.9 C. S. Meal	4.95
Corn 9-10 .....				352.4 Corn	
Tankage 1-10 .....	6	1.04	69	39.2 Tankage	5.18

In the proportion as fed above the cotton seed meal was more efficient than the tankage in saving corn, a result possibly due to the larger proportion of meal. The cotton seed meal also made 100 pounds of pork a little cheaper than did the tankage, as one hundred pounds live weight was made for \$4.95 when the cotton seed meal was used.

but the same one hundred pounds increase in weight cost \$5.18 when the tankage was used.

No deaths occurred in either lot, but there was some danger of deaths in the cotton seed meal lot while there was no danger at all of any deaths in the tankage lot.

There was practically no difference between the two rations so far as daily gains were concerned, both feeds making extremely satisfactory gains.

These tests extended over a period of 91 days.

#### GENERAL VIEW OF RESULTS OF THREE YEARS' FEEDING

##### EXPERIMENTS.

The following table is a summary by periods of the feed fed, the average daily gains, the feed required for one hundred pounds gain, and the cost of one hundred pounds gain each year. Each period is tabulated separately. It should be noted that while this is expressed by periods that some of the lots ran through all three of the periods without a change in feed. Lots five and six during the first two years continued through all three periods without a change. Lots four, five and six were all fed in dry lots and no changes at all were made in their ration:



Table 15.—Summary of rations, gains, feed required for One Hundred pounds gain, and cost of one hundred pounds gain for the three years 1905-06

No. Lot	PERIOD I (Aug. 8—Sep. 26, '06)					PERIOD II (Sep. 21—Nov. 10, '06)					PERIOD III (Nov. 10—Dec. 15, '06)				
	RATION	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain	RATION	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain	RATION	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain
			Lbs	ACS				Lbs	ACS				Lbs	ACS	
1						Peanut pasture Corn	.84	191 Corn	.087	\$2.88	Corn only	.71	587 Corn		\$7.84
2						Peanut Pasture Corn	.98	164 Corn		2.05	Corn 2-3 C. S. Meal 1-3	.88	349 Corn 171 C. S. Meal		6.41
3						{ Peanut Pasture { Corn 2-3 { C. S. Meal 1-3	.99	107 Corn 53 C. S. Meal	.08	1.93	Corn Meal 2-3 C. S. Meal 1-3	.77	384 Corn 192 C. S. Meal		7.20
4						Sorghum Juice Cowpeas 2-3 Corn 1-3	1.11	207 Cowpeas 103 Corn		4.08	{ Sorghum juice { Corn 2-3 { Cowpeas 1-3	1	01 380 Corn 190 C. S. Meal	.089†	7.23
5						Cowpeas 2-3 Corn 1-3	.91	394 Cowpeas 182 Corn		5.18	{ Corn 2-3 { Cowpeas 1-3	.90	390 Corn 180 Cowpeas		6.90
6						Corn only	.67	500 Corn		7.00	Corn only	.66	554 Corn		6.92
1906-07															
1	Period I (Aug. 8—Sep. 26, '06)					Period II (Sep. 26—Oct. 24, '06)					Period III (Oct. 24—Nov. 28, '06)				
	Soiled Sorghum Corn 2-3 C. S. Meal 1-3	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain	Peanut Pasture Corn	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain	Corn only	Average daily Rains	Feed required per 100 lbs gain		Cost of concentrates per 100 lbs gain
			Lbs	ACS				Lbs	ACS				Lbs	ACS	
1			.75	181 Corn 90 C. S. Meal	.13 \$3.90		1.56					1.00	573 Corn		7.16
2			.43	314 Corn 137 C. S. Meal	5.88		1.16	196 Corn		24 \$ 2.43		1.25	221 Corn 110 C. S. Meal		4.15
3			.94	250 Corn 125 C. S. Meal	4.68		.96					.91	883 Corn 100 C. S. Meal		7.33
4			.91	155 Corn 77 C. S. Meal	2.60		.72	305 Corn		.41		.97	206 Corn 103 C. S. Meal		3.80
5			1.16	212 Corn 106 C. S. Meal	3.97		.90	196 Corn 163 C. S. Meal		0.86		.64	202 Corn 105 C. S. Meal		11.83
6			.76	149 Corn	6.03		.80	516 Corn		6.45		.43	1105 Corn		14.93

1907-08

Period I (Sept. 6—Oct. 2, '07)				Period II (Oct. 2—Nov. 8, '07)		Period III (Nov. 8—Dec. 5, '07)		
1	Soy Bean Pasture Corn	1.02 162 Corn	.28 42.02 Corn	Peanut Pasture Corn	1.04	Corn 4-5 Tankage 1-5	1.88 671 Corn 88 Tankage	8.78
2	Grazed Sorghum Corn 2-3 C. S. Meal 1-3	.51 205 Corn 108 C.S.Meal	.87 8.86 Corn	Peanut Pasture Corn	1.14 195 Corn	Corn 2-3 C. S. Meal 1-3	1.88 884 Corn 117 C.S.Meal	4.89
3	Grazed Sorghum Corn	.37 886 Corn	.57 5.57 Corn	Peanut Pasture Corn	.96	Corn only	1.95 883 Corn	4.44
4	Corn 9-10 Tankage 1-10	.98 882 Corn 57 Tankage	4.89 Tankage 1-10	Corn 9-10 Tankage 1-10	.96 480 Corn 48 Tankage	Corn 9-10 Tankage 1-10	1.26 854 Corn 39 Tankage	5.20
5	Corn 2-3 C. S. Meal 1-3	1.01 886 Corn 118 C.S.Meal	4.42 C.S. Meal 1-3	Corn 2-3 C.S. Meal 1-3	1.08 246 Corn 128 C.S.Meal	Corn 2-3 C. S. Meal 1-3	.91 878 Corn 189 C.S.Meal	7.09
6	Corn only	.78 462 Corn	5.77 Corn only	Corn only	.53 621 Corn	Corn only	.46 888 Corn	10.47

† 490 lbs Sorghum Juice.

‡ 988 lbs Sorghum Juice.

† 488 lbs Sorghum Juice.

This area represents the average for both periods. The cane from which the juice was extracted was the large Florida.

As a general thing both the rapid gains and the cheap gains were made when the hogs received some kind of pasture crop in addition to the corn. The best kind of green crops were the leguminous crops, peanuts and soy beans. As far as these experiments show, sorghum has but little value to recommend it as a green crop for finishing hogs—unless abundance of labor should permit the crop to be economically cut and hauled to the animals. Pigs when no larger than those used in these tests cannot graze it to any advantage.

Chufas proved more satisfactory than sorghum.

Table No. 15, in a way also shows the relative stands or yields of peanuts during the three years. The first year but .08 of an acre was required to make 100 pounds of gain, as against .89 of an acre for the third year, or the yield the first year was about ten times as great as that of the third year.

One acre of the various green crops carried 10 hogs (fed a half ration of concentrates) for the following length of time:

One acre of peanuts carried 10 hogs (Av. 3 years) 53 days.

One acre of sorghum carried 10 hogs (1906-'07) 153 days.\*

One acre of sorghum carried 10 hogs (1907-'08) 46.6 days†.

One acre of chufas carried 10 hogs (1906-'07) 32.3 days.

One acre of soy beans carried 10 hogs (1907-'08) 34.4 days.

Since grain was fed with each crop the length of time that an acre was pastured does not indicate the relative value of an acre of the several crops.

It must be remembered that in all of the above cases the hogs received in addition to the green crop, some corn. If the corn had not been fed, of course, it would have required larger areas of green crops to get the same results. By taking an average of the three years' work it is seen that peanut pasture has a greater carrying capacity than any of the other green crops used.

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\*Sorghum was cut and carried to the hogs which were fed in a dry lot.

†Sorghum grazed.

SHALL HOGS WHICH HAVE BEEN GRAZED UPON GREEN CROPS  
BE FINISHED IN A DRY LOT UPON GRAIN?

The majority of the farmers of the State who make use of green crops for fattening hogs sell the hogs directly upon the market when the crop is exhausted without finishing them upon grain for a short time in a dry lot. A study of period 3 (table 15) will throw some light upon this practice; it will help to determine whether it is profitable to feed in a dry lot for a few days upon grain alone. There are some contradictions when the three years' work are compared. The work of the first year favors selling hogs directly off the green crops; that is, the finishing period of thirty five days of dry lot feeding was a losing proposition in all cases for this year. In fact the hogs which had been fed in a dry lot throughout the entire test went through the finishing period more economically than did those hogs which had grazed peanuts for fifty days previous to the finishing period. But during the last two years' work those hogs which had been previously grazed upon a green crop made their gains in the third period more cheaply than did those which had never been given the run of a pasture crop.

During the second year's third period money was lost in the case of two lots, 1 and 3, (previously pasturing peanuts) the gains when feeding in dry lots costing from \$7.16 to \$5.39 per hundred, and these gains could be sold for only \$5.00 per hundred on the local market. If these hogs could have been put upon some of the larger markets in the South there would probably have been some profit even in these two lots. In all lots in 1907-'08, where the hogs were finished for a period of twenty eight days after taking off of peanuts, the subsequent period of dry lot feeding was found to be exceedingly profitable. During this year's work the lots which had previously been upon peanuts made unusually large gains, and made these gains economically. While the results are not all in agreement, yet they seem to indicate that it is more often profitable to finish

hogs upon dry feeds rather than to sell directly from pasture.

In all three years' work cotton seed meal was found to be a very valuable feed with which to supplement corn for finishing hogs after they had been grazed upon a green crop,—in fact the most valuable of any so far tried. That is, these finishing gains can be made more cheaply through the use of cotton seed meal combined with corn than by the use of corn alone, or corn supplemented with tankage. Cotton seed meal is an excellent feed for fattening purposes. On the average the data show that corn and cotton seed meal can be used very profitably as a short finishing feed. In other words it is usually advisable to combine corn and cotton seed meal and to dispose of some of the corn on the farm by feeding during a short finishing period, say 20 days, after the hogs have been taken off of the peanut pasture, because usually more than 70 cents a bushel can be realized upon the corn by this practice. It might not be a wise thing to keep the hogs upon this feed for as long as twenty-eight days, as deaths may occur from feeding the cotton seed meal for this length of time. In these tests no animals have died from feeding cotton seed meal for 28 days during the finishing period. It will be perfectly safe to use the cotton seed meal for at least twenty days.

There is another advantage to be gained by finishing hogs for a short period after taking them off of green crops, namely, better prices can be realized for them when placed upon the market. The hog looks better, and is actually worth more to the consumer or packer, as he is fatter and will dress out a higher per cent of good marketable meat than if he had been sold directly from the pasture. The corn-fed hog has a decided advantage in all the Southern markets.

In this connection the point should not be overlooked how extremely expensive the gains become along about the last month of feeding when hogs are being fattened upon corn alone, running from \$7.00 a hundred in one case to

about \$15.00 per hundred increase in live weight in another case.

When hogs have been grazed upon peanuts, and certain other green pastures, there is yet another advantage to be gained in feeding them upon dry feeds a short time before selling. It is well known that peanuts soften the meat very much, so that it is not as acceptable to many butchers and to the packers as the animals that have been fed upon grain alone. This soft meat can be hardened very materially, if the hogs are fed upon grains only for a short period after the peanuts are exhausted. Corn is good; corn in combination with cotton seed meal is better than corn alone, as the addition of some cotton seed meal to the ration renders the meat hard more rapidly than when corn alone is used.

#### SUMMARY OF AVERAGE RESULTS FOR THREE YEARS:

In table number sixteen is brought together the summary, or average, of the experimental work for three years.

The average shows that large gains and cheap gains go with the use of green crops and that the best green crops are the legumes. The table also demonstrates strikingly that small gains and the high priced gains go with the use of corn exclusively. Every supplement used with corn cheapened the gains, no matter whether it was a pasture supplement or another concentrate—except when the cost of putting in and cultivating the crops was charged against the gains, when sorghum and chufa pastures were found to be of no advantage.

In comparing lots 2 and 3 there seems to be an apparent contradiction to the data presented heretofore; that is: table No. 14 taught that cotton seed meal produced gains more economically than did the tankage, while in this table the cheaper gains seem to have been made with tankage. This is due to the fact that the data for lot 2 in the present table are a summary of two years' work, while in table 14 only the last year's test was used, so that a direct comparison could be made between the cotton seed

Table 16. Average total summary of 1905-'06; 1906-'07; 1907-'08.†

No. Lot	Ration	No. Pigs in Test	Average Daily Gains	Feed Required Per 100 lbs. Gain		Cost of Concentrates Per 100 lbs. Gain
				Concen- trates	Pasture Areas	
1	Corn only .....	15	Lbs .69	Lbs. 611 Corn	Acre	\$7.63
2	Corn 2-3 .....	11	1.04	303 Corn		
	C. S. Meal 1-3 .....			157 C. S. Meal		5.75
3	Corn 9-10 .....	6	1.04	352 Corn		
	Tankage 1-10 .....			38 Tankage		5.18
4	Corn 1-2 .....	4	.94	187 Corn		
	Cowpeas 1-2 .....			207 Cowpeas		5.11
5	*Corn .....	32	1.01	183 Corn	.44	2.28
	Peanut pasture .....					
6	*Corn Meal 2-3 .....	4	1.00	107 Corn		
	C. S. Meal 1-3 .....			51 C. S. Meal	.08	1.97
	Peanut pasture .....					
7	Corn .....	6	.37	437 Corn	.57	5.36
	Sorghum past'r .....					
8	Corn 2-3 .....	11	.46	259 Corn		
	C. S. Meal 1-3 .....			129 C. S. Meal	.26	4.85
	Sorghum past'r .....					
9	Corn .....	3	.72	305 Corn	.41	3.81
	Chufa pasture .....					
10	Corn .....	6	1.02	158 Corn	.28	1.96
	Soy bean past'r .....					
11	Corn Meal 2-3 .....	5	.75	181 Corn		
	C. S. Meal 1-3 .....			90 C. S. Meal	.13	3.39
	Soiled sorghum .....					

\*Lots 5 and 6 are not comparable. It would seem, on the face, that the addition of cotton seed meal to the corn and peanut ration worked wonders, but this cannot be compared to lot 5 as lot 5 takes in all the years, (and the last two years had very poor stands), while the data in lot 6 were obtained only in 1905 when the stand of peanuts was extra good.

†Cost of putting in and cultivating the pasture crops not taken into consideration.

meal and the tankage. Table 14 is more reliable on this single point than the present table.

The results from the use of the chufa pasture has not been discussed so far, as so few animals were used that any conclusions drawn could not be relied upon absolutely. But, looking at lot 9, it is seen that the daily gains made upon the chufa pasture, while not as good as those made upon soy bean and peanut pastures, are much better than those made when sorghum was used. It is also seen that the chufa pasture saved corn.

COST OF GAINS WHEN MANURAL VALUE AND EXPENSE OF  
PUTTING IN AND CULTIVATING THE CROPS ARE  
CONSIDERED.

In the above table there has been no expense charged against the hogs on account of putting in and cultivating the pasture crops. Neither has there been any credit given to the soil by reason of there having been grown upon it leguminous crops. The manure dropped by the animals while grazing the crops has not been credited to the soil.

Of course there is no figure which will express the exact cost of putting in a crop under all conditions, as conditions vary with different localities. Neither are there any exact figures to tell just how much good will come to the soil as a result of growing a leguminous crop; this varies with different soils and with many other conditions. So the following estimate is based upon the approximate average cost of putting in crops upon the Station farm, and the fertilizing value of a leguminous crop is based upon work done here and reported in previous bulletins.

The cost of putting in and cultivating each acre of the various crops, counting labor at eighty cents a day and one man with one mule at one dollar a day, was approximately as follows:

**PEANUTS:**

To one bushel seed.....	\$ 1.90
To commercial fertilizer .....	1.50



To breaking the land .....	1.00
To harrowing the land .....	.20
To putting down the seed and fertilizer .....	1.00
To cultivating three times .....	1.20
To hoeing one time .....	.80
To rent or interest .....	2.00
Total cost of each acre .....	<u>\$9.60</u>
By assumed increase in next year's crop due to fertilizer effect of peanuts and grain fed (partly based on Alabama Bulletins 120 and 137).....	\$ 7.50
Net cost of one acre peanuts .....	<u>\$ 2.10</u>

**SOY BEANS:**

To one bushel seed .....	\$ 2.20
To commercial fertilizer .....	1.50
To breaking the land .....	1.00
To harrowing the land .....	.20
To putting down the seed and fertilizer .....	1.00
To cultivating four times .....	1.60
To hoeing one time .....	.80
To rent or interest .....	2.00
Total cost of each acre.....	<u>\$10.30</u>
By assumed increase in next year's crop due to fertilizing effect of peanuts and grain fed.....	\$ 7.50
Net cost one acre soy beans .....	<u>\$ 2.80</u>

**SORGHUM:**

To one-half bushel seed .....	\$ .75
To commercial fertilizer .....	5.00
To breaking the land .....	1.00
To harrowing the land.....	.20
To putting down the seed and fertilizer .....	.75
To cultivating four times .....	1.60
To rent or interest on land .....	2.00
Total cost of each acre .....	<u>\$11.30</u>
(No credit for soil improvement)	

**CHUFAS:**

To one peck of seed .....	\$ 1.00
To commercial fertilizer .....	5.00
To breaking the land .....	1.00
To harrowing the land .....	.20
To putting down the seed and fertilizer .....	1.00
To cultivating four times .....	1.60
To hoeing one time .....	.80
To rent or interest on land .....	2.00
Total cost of each acre chufas.....	<u>\$12.60</u>
(No credit for soil improvements).	

Counting the expense of putting in and cultivating the green crops as above, the cost of making one hundred pounds gain on the hogs in each one of the lots was as follows:

TABLE 17.

Lot 1—Corn alone .....	\$ 7.63
Lot 2—C. S. Meal 1-3 .....	5.75
Corn 2-3	
Lot 3—Corn 9-10	
Tankage 1-10 .....	†5.18
Lot 4—Corn 1-2	
Cowpeas 1-2 .....	5.11
Lot 5—Corn	
Peanut pasture .....	*3.20
Lot 6—Corn 2-3	
C. S. Meal 1-3 .....	*2.14
Peanut pasture	
Lot 7—Corn	
Sorghum pasture .....	11.96
Lot 8—Corn 2-3	
C. S. Meal 1-3 .....	†7.79
Sorghum pasture	
Lot 9—Corn	
Chufa pasture .....	†8.98
Lot 10—Corn	
Soy Beans .....	2.74
Lot 11—Corn 2-3	
C. S. Meal 1-3 .....	†4.86
Soiled sorghum	

When all expenses are *charged against putting in these green crops*, it is seen that sorghum makes a very poor showing, even inferior to corn when fed alone. Looked at from every point of view it seems that mature sorghum (pastured) has no place as a feed for finishing swine. It seems that it might, under certain conditions where labor can be contracted and secured cheaply, be a profitable

\*Lots 5 and 6 not to be compared; see foot note to Table 16.

†Data for one year only.

thing to grow sorghum and cut it when ripe and carry it to the hogs. In lot II, where it was so handled economical gains were made; but the labor of cutting the sorghum and carrying it to the hogs has not been included in the estimate. The hogs made very much more economical use of the sorghum as far as the sorghum itself was concerned, when it was cut and fed to them in a dry lot than when they were permitted to graze it, that is, the waste was not so great in soiling sorghum.

The chufa pasture also made a very poor showing, but the gains were somewhat cheaper than when the sorghum pasture was used. Neither sorghum nor chufas are legumes.

The greatest profits were made when a leguminous crop was used to supplement the corn. In fact, in all cases where either peanuts or soy beans were used profits were realized even if no credit be given for the improvement of the soil. The results in lot 6 more nearly represents what the farmer can expect from the use of peanuts than those with lot 5, as lot 6 represents only one year's experiment, when there was a good stand of the nuts, while lot 5 is an average of all the three years' work, which includes two years of very poor crops.

TABLE 18. *Financial Statement. (Summary 1905-'06  
1906-'07, 1907-'08.)*††

No. Lot	Ration	No. Pigs Used	Initial Cost of Whole Lot	Cost of Grain Given each Lot	Total Cost of the Hogs Plus the Concentrates	Selling Price Whole Lot at 6 cts per lb.	Profit on Whole Lot	Profit Per Pig After Charging Corn Against them at 70 cts per bu.	Price Actually Realized for each Bu. Corn
1	Corn only.....	15	\$ 56.30	\$59.60	\$111.50	\$ 97.90	\$-18.00	\$-1.20	\$ .48
2	Corn 2-3 C. S. Meal 1-3.....	11	42.20	54.15	96.35	90.65	- 5.70	- .51	.59
3	Corn 9-10 Tankage 1-10.....	6	20.85	24.49	45.35	44.35	- .99	- .16	.66
4	Corn 1-2 Cowpeas 1-2.....	4	13.50	16.13	29.63	27.00	- 2.63	- .65	.47
5	Corn Peanut past'r.....	32	142.20	26.10	168.20	199.00	30.80	.96	†1.53
6	Corn 2-3 C. S. Meal 1-3 Peanut past'r.....	4	11.85	3.95	15.80	21.80	6.00	1.50	†2.30
7	Corn Graz'd sorgh'm.....	6	21.95	4.26	26.21	25.85	.36	.06	.64
8	Corn 2-3 C. S. Meal 1-3 Graz'd sorgh'm.....	11	45.00	10.46	55.46	55.75	.29	.03	.72
9	Corn Chufa past'r.....	3	16.40	2.33	18.73	20.05	1.32	.44	1.10
10	Corn Soy bean past'r.....	6	23.20	4.26	27.46	34.00	6.54	1.09	1.80
11	Corn 2-3 C. S. Meal 1-3 Soiled sorgh'm.....	5	20.70	5.05	25.75	30.00	4.25	.85	*1.58

\*Labor of cutting and hauling is not included.

†And the other feeds as figured on page 6.

†Lots 5 and 6 are not comparable; see note to Table 16.

††Taking no account of the cost of growing the pasture crops.

From the financial statement in table 18 it is seen that when corn is worth 70 cents a bushel, cotton seed meal \$25.00 per ton, tankage \$40.00 a ton, and cowpeas 80 cents a bushel, some of the lots made good profits, while other lots were fed at a financial loss. That is, some of the lots of hogs returned more than the market price for the feeds used while some of the lots did not make gains economical-

ly enough so that the usual market prices for corn and the other grains used could be realized. By the use of certain combinations of feeds it was a very profitable thing to do to dispose of the corn by means of feeding hogs; more was made by thus disposing of it than if it had been sold directly upon the market at 70 cents a bushel; when the corn was fed incorrectly, or not judiciously, money was lost by feeding it to the hogs.

Lot 1, the corn lot, made the greatest loss of any of the pens; lot 6 made the largest profits. The corn lot lost \$1.20 per pig. This was a very heavy loss for the pigs weighed but 130 pounds each. From a financial standpoint it proved to be advisable to supplement the corn ration with cotton seed meal and tannage.

The ration of corn one-half plus cowpeas one-half was not as profitable as when corn was supplemented with the cotton seed meal or tannage, there being a loss upon each pig of \$.65 when fed on cowpeas and corn. It is but fair to state that under present conditions, and in fact since 1905, the financial showing in lot 4, where corn and cowpeas were fed would not be as good as the above data represent, for when the test was made the cowpeas were purchased for 80 cents a bushel, and have been so figured in the financial statement, but it has been impossible to purchase them for the above price since that date.

Where pasture crops were used in combination with grain good profits were made possible—that is, more than 70 cents a bushel was realized upon corn from the feeding operations. This last table does not include the cost of putting in and cultivating the green crops, neither does it take into consideration the value to the land in having the pigs graze upon it. But if the manurial value be eliminated altogether and the pigs be charged with the cost of putting in and tending the crops it is still found that excellent profits were made when peanuts and soy bean pastures were used, but when chufa and sorghum pastures were used money was lost. The legumes made the best showing by far. In fact, when the cost of putting in the crops is

charged against the hogs the sorghum lots lost more money than did the lots upon corn alone.

This table again emphasizes the fact that money cannot be made by finishing hogs through the use of corn alone. The farmer cannot expect to sell his corn for 70 cents a bushel through hogs when the hogs have nothing else to eat except the corn—that is, he cannot do it when the hogs sell at five cents per pound live weight. The farmer could not afford to feed corn alone, no matter how high hogs might sell, for much more could be made out of the corn by combining it with some other feeds, either green or concentrated.

The last column in table 18 brings out some valuable points; here we find tabulated the prices which were obtained for each bushel of corn fed. In lot 1, where corn alone was fed, but \$.48 per bushel was realized by feeding the corn to the hogs. When corn was supplemented with cotton seed meal and tankage the corn was sold through the hogs for \$.59 and \$.66 respectively. That is, through feeding tankage with corn the value of the corn was increased 18 cents a bushel. The greatest value was gotten from the corn when it was fed in connection with the leguminous crops, peanuts and soy beans; in these cases the prices received for the corn varied from \$1.53 per bushel up to \$1.80 per bushel. Much more was made out of the corn when it was fed in connection with a leguminous crop than would have been made had it been sold directly upon the market.

#### PROFITS REALIZED WHEN HOGS WERE SOLD AT VARYING PRICES.

The preceding table represents the profits and losses just as they actually occurred at Auburn under the local market conditions. The hogs were bought for 5 cents a pound live weight and sold for 5 cents, upon the local market after being fed for from 84 to 112 days. If the hogs could have been placed upon Montgomery, Mobile, Birmingham, or New Orleans markets they would have

brought from 6 to 7 1-2 cents per pound on foot. So to illustrate what would have been made or lost under these varying conditions the following table is attached:

TABLE 19. *Profits realized when hogs are sold at various prices.†*

No. Lot	Ration	Profits per Pig when bought at 50 per lb. and sold at:- (after feeding from 84-112 days)					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone .....	-1.20	-.55	\$ .11	\$ .75	\$1.41	\$2.06
	Corn 2-3 .....						
2	C. S. Meal 1-3.....	-.51	.31	1.13	1.95	2.78	3.60
	Corn 9-10 .....						
3	Tankage 1-10 .....	-.16	.57	1.32	2.05	2.79	3.53
	Corn 1-2 .....						
4	Cowpeas 1-2 .....	-.65	.02	.69	1.33	2.04	2.72
	Corn .....						
*5	Peanut pasture .....	.96	1.58	2.21	2.83	3.45	4.07
	Corn 2-3 .....						
*6	C. S. Meal 1-3.....	1.50	2.04	2.68	3.12	3.66	4.20
	Peanut pasture .....						
	Corn .....						
7	Grazed sorghum .....	.06	.48	.92	1.35	1.78	2.21
	Corn 2-3 .....						
8	C. S. Meal 1-3.....	.04	.54	1.04	1.58	2.12	2.62
	Grazed sorghum .....						
	Corn .....						
9	Chufa pasture .....	.44	1.10	1.76	2.42	3.08	3.76
	Corn .....						
10	Soy bean pasture.....	1.09	1.65	2.21	2.77	3.33	3.89
	Corn 2-3 .....						
11	C. S. Meal 1-3.....	.85	1.45	2.05	2.65	3.30	3.95
	Soiled sorghum .....						

†Cost of putting in crop not taken into account.

\*Lots 5 and 6 are not comparable.

TABLE 20. *Prices realized upon each bushel of corn when hogs were sold at various prices.*

No. Lot	Ration	Price Actually Realized for Corn per Bushel when the Hogs were bought at 5 cts. and sold at					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone .....	\$ .48	\$ .60	\$ .72	\$ .84	\$ .96	1.08
	Corn 2-3 .....						
2	C. S. Meal 1-3 .....	.59	.77	.95	1.13	1.38	1.49
	Corn 9-10 .....						
3	Tankage 1-10 .....	.66	.77	.88	.99	1.10	1.21
	Corn 1-2 .....						
4	Cowpeas 1-2 .....	.47	.71	.95	1.19	1.43	1.67
	Corn .....						
*5	Peanut pasture .....	1.53	2.03	2.53	3.03	3.53	4.03
	Corn 2-3 .....						
*6	C. S. Meal 1-3 .....	2.33	2.92	3.51	4.10	4.65	5.28
	Peanut pasture .....						
	Corn 2-3 .....						
7	Sorghum pasture ....	.64	1.06	1.48	1.90	2.32	2.74
	Corn 2-3 .....						
8	C. S. Meal 1-3 .....	.72	1.28	1.48	2.40	2.96	3.52
	Sorghum pasture ....						
	Corn .....						
9	Chufa pasture .....	1.10	1.71	2.32	2.93	3.54	4.15
	Corn .....						
10	Soy bean pasture ....	1.80	2.36	2.93	3.48	4.04	4.60
	Corn 2-3 .....						
11	C. S. Meal 1-3 .....	1.58	2.20	2.82	3.44	4.06	4.68
	Soiled sorghum .....						

\*Lots 5 and 6 are not comparable.

†Cost green crop not considered.

If the hogs could have been sold at 6 cents a pound instead of at 5 cents a pound, every lot, even the corn lot would have been fed at a profit. Even when sold at 5 1-2



cents a pound all lots except the corn lot were profitably fed.

In these tests when the hogs were bought at five cents per pound and fattened and sold at five cents per pound, but 48 cents was realized per bushel for corn when corn was fed alone. This is about 22 cents a bushel less than could be secured for the corn if it had been sold directly upon the market. But when pigs were bought at five cents a pound and sold at seven cents a pound 96 cents was realized upon each bushel of corn even when nothing but corn alone was used.

But in every case where corn was fed in combination with some other feed a better price was secured for the corn, when neither the manurial value nor the cost of putting in the crop were considered; that is, corn was made more efficient by the addition of the various supplements. For instance in lot 5, where peanut pasturage was the supplement, \$1.53 was realized upon each bushel of corn (not counting cost of pasture crops) when hogs were bought at five cents and sold at the same price, and \$3.53 was realized upon each bushel of corn when they were bought at five cents and sold at seven cents per pound live weight.

This table brings out the point distinctly that when hogs sell as they have been selling in the South for the last few years that the farmer cannot afford to sell his corn upon the market at 70 cents per bushel, or even at \$1.00 per bushel. The best and most profitable way to sell corn is to combine it with some other feed and sell it through hogs or some other live stock.

#### SLAUGHTER DATA.

In many parts of the State the local butchers quote the dressed weights of the hogs two cents higher than the live weight. For instance upon the Auburn market for the last three years the farmers have been given the choice of selling their hogs either at 5 cents a pound live weight or 7 cents a pound dressed weight. These quotations have stood inflexible, no reference at all being made to either

the degree of fatness or to the conformation or type of the animals offered.

TABLE 21. *Should the farmer sell his hogs at five cents live weight or seven cents dressed weight?*

Ration	No. Pigs	Average Live Weight at Killing Time	Average Dressed Weight	Per Cent Dressed Weight to Live Weight	Value each Pig at 5 cts. Live Weight	Value each Pig at 7 cts. Dressed Weight
Corn only .....	12	131	96	73.28	\$6.50	\$6.72
Corn 2-3 .....	9	181	130	71.82	9.05	9.10
C. S. Meal 1-3 .....						
Corn 9-10 .....	5	158	116	73.42	7.90	8.12
Tankage 1-10 .....						
Corn .....	5	131	100	76.33	6.55	6.00
Peanut pasture .....						

While the above table does not include all the data that has been collected from the slaughtered animals, sufficient facts are presented to bring out the point that when hogs are fat enough to kill out about 72 per cent dressed weight that it makes practically no difference whether they are sold at 5 cents a pound live weight or 7 cents a pound dressed weight. This table does not take into consideration the expense of killing the hog, which must be charged against the hog when he is delivered dressed, neither does it take into account the value of the internal fat and the other organs which go to the farmer when the contract calls for dressed animals. In most instances the value of the internal organs will just about pay for the expense of killing.

The point is brought out that when a hog is excessively fat, which means that he will dress about 80 per cent, it is more profitable to the farmer to sell him at 7 cents dressed weight than to sell him at 5 cents live weight. It would,

of course, be more profitable from the butcher's stand-point to buy him on the basis of live weight. That is, the fatter the hog the greater should be the difference between the live weight and the dressed weight quotations, so that all parties concerned may be treated with fairness.

Then, on the other hand, the type of hog, which is represented by the razor back, the small hammed, narrow backed, long legged kind, will lose the owner more money when they are sold at 7 cents dressed weight than when they are sold at 5 cents a pound live weight, because this type dresses out a small proportion of saleable parts. That is, the nearer the hog comes to representing the razor back type the smaller should the net quotations be over the live weight quotations.

The butcher who does not take these things into consideration is not treating his customers fairly. The man who raises hogs of correct type and takes pride in finishing them to prime condition is being discriminated against when the butcher has an arbitrary price like the above. Before a just value can be placed upon a bunch of hogs they must be seen, so that both type and the degree of fitness can be taken into consideration.

#### SOME GENERAL CONSIDERATIONS IN SWINE PRODUCTION.

It is sometimes claimed that pork production cannot be made a profitable business in the South since corn has advanced in prices. It is often said that the farmer can buy his pork cheaper than he can make it. But it must be remembered that pork has advanced in price as well as corn, that the cheapest side meat now costs from 10 to 12.5 cents a pound, and that hams and shoulders cost from 15 to 20 cents a pound. Corn has advanced in price more rapidly than has pork, but the South is in a position to change her feeding methods when corn, as a sole feed, gets out of reach. The Southern hog prices are higher than at either the St. Louis or Chicago markets. At the present writing, prices all over the South are substantially higher than they

are in Chicago. All conditions here are encouraging for hog production; we can grow the corn, we have the best markets, as far as prices are concerned, in America; and we can grow many kinds of pasture crops, the crops which cheapen pork production more than any other feed.

It is generally considered that there is no other feed equal to corn for pork production,—this is true, provided the corn is used judiciously. If it be fed alone for any length of time there are few feeds which are poorer than corn, as the preceding experiments strikingly demonstrate, but if it be fed in combination with other feeds its use is to be highly commended, and it can be used to great economical advantage, too, even though it sells upon the market for 70 cents a bushel.

The hog is not adapted to living on corn alone, and when we require it of him we are forcing him to do a thing which is not consistent with his nature. Man likes a mixture of feeds or a change in diet; so do the lower animals. The hog in its wild state is not compelled to live upon one feed alone. When wild and free to make its own choice he is omnivorous, feeding upon roots, nuts, fish, grass, fruit, snakes, and in fact, but few feeds can be mentioned that he will not eat if he be given the opportunity. Our domesticated hogs have inherited the tendency to select their foods from a variety of substances, and when we enclose them in a pen and feed but one feed we can feel assured that we are not allowing them to reach their highest possibilities.

Probably those who claim that pork cannot be produced in the South at a profit mean that it cannot be produced on corn alone at a profit; if so, that is entirely correct. Experimental data show that pork cannot be profitably raised and finished upon corn alone when corn sells for 70 cents a bushel. The following table, made up from data collected from all parts of the United States, clearly demonstrates the fact that the man who tries to finish hogs on corn alone is following a losing business;

Table 22. Corn alone for fattening hogs.

Station	No. Pigs	Length Exp. <i>Days</i>	Average Daily Gains <i>Lbs.</i>	Lbs. Fed to make 100 lbs. Gain	Cost 100 lbs. gain when Corn is:—			
					40 cts.	50 cts.	60 cts.	70 cts.
Texas .....	10	83	.46	762	\$ 5.44	\$ 6.80	\$ 8.15	\$ 9.52
Texas .....	10	83	.43	868	6.20	7.75	9.30	10.85
Tennessee ..	3	60	1.00	460	3.88	4.10	4.93	5.75
Tennessee ...	3	60	1.00	416	2.97	3.72	4.46	5.20
Tennessee .....	7	.....	.50	410	2.93	3.6	4.39	5.12
Alabama .....	3	60	.....	806	5.76	7.20	8.63	10.07
Alabama .....	3	35	.....	670	4.79	5.98	7.18	8.37
Alabama .....	3	56	.40	621	4.43	5.54	6.65	7.76
Alabama .....	15	96	.69	611	4.36	5.45	6.55	7.64
Indiana .....	3	70	1.56	432	3.09	3.86	4.63	5.40
Indiana .....	4	127	.67	520	3.72	4.65	5.57	6.50
Oklahoma ...	4	126	.62	470	3.36	4.19	5.03	5.87
Iowa .....	6	49	2.08	461	3.29	4.12	4.95	5.74
Wis. (4 trials) ..	35	.....	1.69	459	3.28	4.09	4.87	5.74
Wis. (4 trials) ..	35	.....	1.41	499	3.57	4.45	5.35	6.24
Average ..	.....	.....	.....	564	4.01	5.4	6.04	7.02

The average farmer under ordinary conditions will not miss the average far. And the average of the preceeding table points out the fact that when corn is worth 70 cents a bushel that the cost of each pound of gain will be just about 7 cents, when corn is selling at 60 cents a bushel each pound of gain put on will cost 6 cents, when corn is worth 50 cents a bushel each pound of gain will cost 5 cents, and when corn is worth only 40 cents a bushel pork can be made for only 4 cents a pound. The table shows that when 70-cent corn is fed to 5-cent hogs that the feeder is losing 20 cents per bushel on his corn. To come out even in Alabama 70-cent corn must go along with 7-cent pork if the owner is to strike even on feeding corn alone. As a general thing the farmers do not get 7 cents for their hogs. If corn were worth but \$.40 per bushel, as it is in some of the Western States, it would be a very profitable thing to raise corn and feed it to 5 and 6-cent hogs; good

money could be made out of it, as the farmer would then be selling his \$.40 corn by means of hogs at from \$.50 to \$.60 per bushel. But even in the corn belt States it is more profitable to supplement the corn with other concentrates or green crops,—a practice followed by the best Northern farmers.

The data recorded in this bulletin point the way to cheaper pork production in Alabama. If we are to make the most that there is to be made from pork, and at the same time build up and maintain our soils, we must make a liberal use of green crops. Alabama can grow green crops almost the year round as indicated by the following table:

*Table 23. Succession of green crops suitable for hog grazing:*

<i>For fall planting.</i>			
Crop	Time to Plant	Amount Seed Per Acre	No. days from planting time until grazing time
Alfafa	Sep't. 1 to Oct. 15	15 to 25 lbs.	90 to 120
Burr clover	Sep't. 1 to Oct. 1	15 to 20 lbs. cleaned seed	90 to 120
Oats	Sep't. 1 to Nov. 1	36 lbs. in burr	90 to 120
Rape	Sep't. 20 to Oct. 15	1½ to 3 bu.	90 to 120
Rye	Sep't. 1 to Nov. 1	4 to 6 lbs. drilled	60 to 75
Vetch	Sep't. 1 to Oct. 15	5 to 10 lbs. broadcast	90 to 120
		1½ to 2 bus.	90 to 120
		1 bu.	90 to 120
<i>For spring and summer planting.</i>			
Alfafa	Feb. 25 to April 1	15 to 25 lbs.	75 to 90
Chufas	Mar. 15 to June 1	3 to 4 pks.	120 to 150
Cowpeas	May 1 to July 10	½ bu. drilled	75 to 90
Japan clover	Mar. 1 to Mar. 15	1½ bu. broadcast	60 to 75
Oats	Feb. 1 to Mar. 20	24 lbs.	60 to 75
Peanuts	May 1 to June 30	1½ to 3 bus.	75 to 90
Rape	Mar. 1 to Mar. 31	1 to 2 bu. unhulled	90 to 120
Sorgum	April 1 to June 30	4 to 6 lbs. drilled	60 to 75
Soy beans	April 1 to June 30	9 to 10 lbs. broadcast	60 to 90
		1½ to 2 bus.	60 to 90
		½ bu. drilled	90 to 120
		1½ bu. broadcast	90 to 120

Through the use of these crops the expense of carrying the brood sows and boars through the year can also be

greatly reduced. Many of these crops would keep the sows in a fat condition without the use of any grain at all,—and it is the grain that costs the money in Alabama.

Another point is too often overlooked, but is of great moment to Southern soil maintenance, and should be considered in all cases where live stock is handled—the relation of live stock to soil fertility. The farmer who keeps live stock has a fertilizer factory upon his own farm. Stock will improve the soil to such an extent that poor soils can within a few years be made to produce a bale of cotton to the acre.

Producing hogs is an excellent method by which soils can be maintained and built up. In 1898 the Arkansas Station grazed hogs upon areas of peanuts, chufas, and soy beans. The two years following 1898 the land was planted in cotton and data was collected to determine what effect this grazing might have upon cotton yields. The results per acre were as follows:

*Table 24. Fertilizing effect of crops grazed by hogs:*

	Seed Cotton 1899	Seed Cotton 1900	Average yield seed cotton 1899-1900	Average per cent increase in seed cotton due to grazing and growing the crop	Value of increase per acre each year (lint 11c, seed 60c)
Cotton following peanuts grazed by hogs.....	1771	1134	1452.5	61.1	\$23.81
Cotton following soy beans grazed by hogs.....	1588	1020	1304.0	44.6	16.35
Cotton following chufas grazed by hogs .....	1200	981	1090.	20.9	7.63
Cotton following corn not grazed .....	1005	798	901.5	.....	.....

The effect upon the soil of growing a legume and then grazing it off with hogs is remarkable; for instance in the case of soy beans and peanuts the increased yield of cotton was 44.6 per cent and 61.1 per cent respectively. The

effects of growing these crops and grazing them off does not stop with the cotton crop grown the first year following the grazing; the data show that the increase over the corn lot was still considerable in the second year.

Of course, in the case where peanuts and soy beans were used the increased cotton yields were not due entirely to the grazing; part of the benefits were due to the fact that the crops were legumes, thus placing nitrogen in the soil for the use of subsequent crops. But with chufa pasture we have a case in hand where the increased cotton yields could have been due to nothing except the grazing and the supplementary grain fed, as the chufa plant is not a legume. In this case the increased cotton yields for the average of the two years following the chufas, which had been grazed off, was 20.9 per cent over the cotton crops which had followed a corn crop without being grazed off by the hogs. That is, a farmer can expect to get more cotton when it is planted on an area where hogs have grazed or where peanuts, soy beans, or other legumes have been grown than he can secure from an area where hogs have not been grazed.







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**THE SAN JOSE SCALE AND LIME-SULFUR WASH**

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**BY**  
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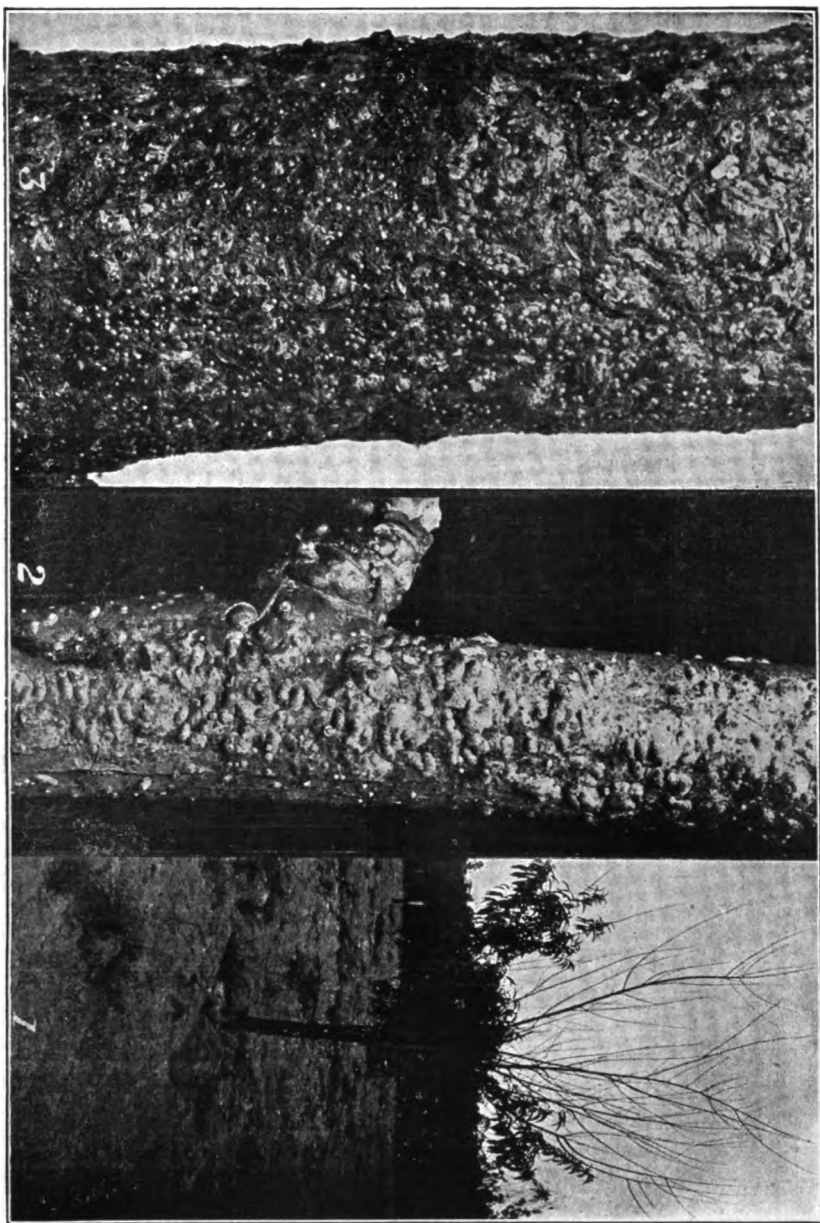
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PLATE I.

THE SAN JOSE SCALE AND ITS WORK.

FIG. 1.—Peach tree with iron killed by the scale.

FIG. 2.—Peach twig moderately infested. Abundant scale and fructification.





## THE SAN JOSE SCALE AND LIME-SULFUR WASH

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BY

W. E. HINDS, PH. D.

*Entomologist to Alabama Experiment Station.*

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ORCHARD INTERESTS OF ALABAMA.—The culture of orchard fruits, particularly peach, plum, pear and apple, is already a very important factor in the agricultural prosperity of Alabama. As nearly as we are able to estimate from the data available there are about 8,000,000 trees of these four kinds now growing in this State. Soil climate and market conditions are exceedingly favorable to a large increase in the growth of these fruits. The extension of the present important movement for the production of a greater diversity of crops, the substitution of other, and more profitable, crops for cotton and the adoption of improved methods for the culture of all crops grown will undoubtedly result in a great increase in fruit growing within the next few years. The growth of these fruits for wholesale commercial shipments and for the supply of the home markets as well, should increase largely as a profitable business proposition.

DANGER FROM SAN JOSE SCALE.—The principal difficulty to be met in maintaining present and in increasing future fruit culture is the necessity for controlling the insect enemies which, if left uncontrolled, may partially, or entirely, destroy the crops of fruit or even the life of the trees themselves. The most important insect affecting the four species of trees mentioned is the San Jose scale (pronounced "San Hosay") known scientifically as *Aspidiotus perniciosus* Comst. This is the most deadly enemy of fruit-growing known. The name itself means "most injurious scale" and it was well chosen.

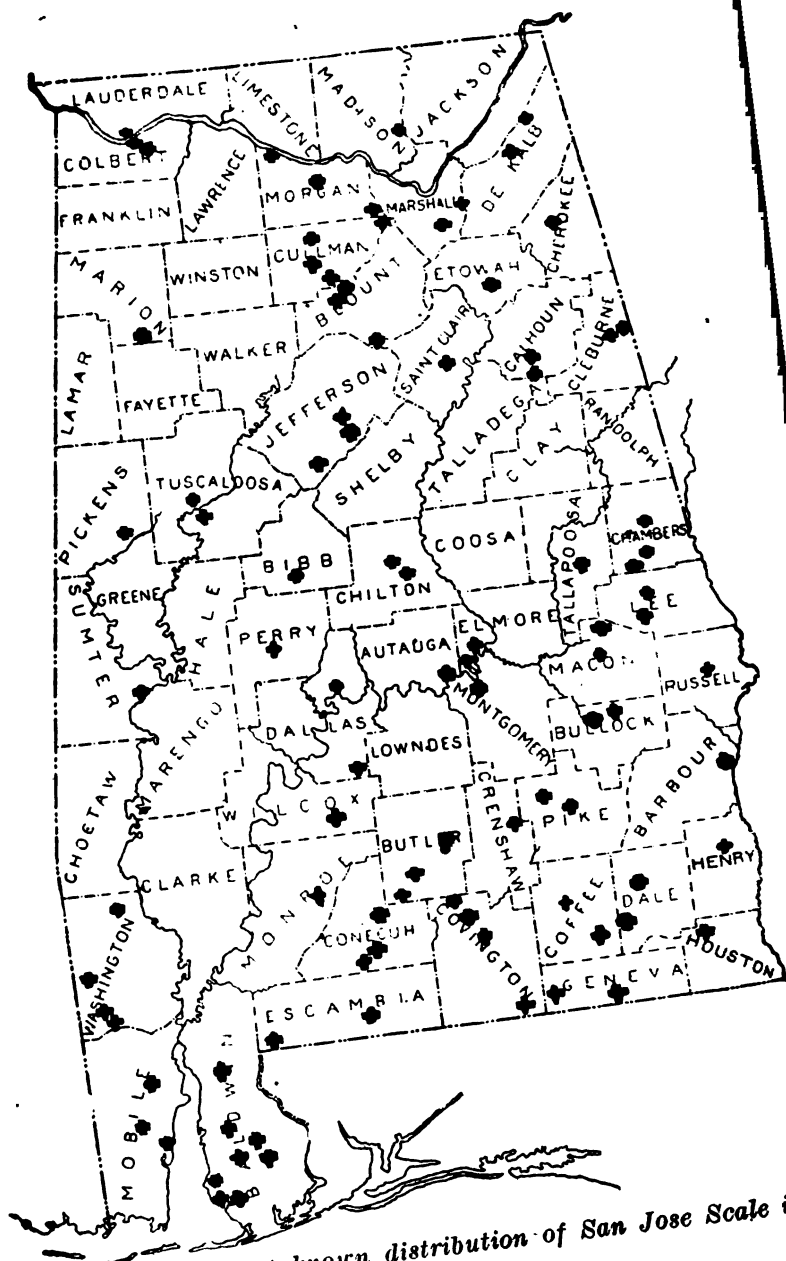


FIG. 1. Present known distribution of San Jose Scale in Alabama.

**INTRODUCTION AND SPREAD OF THE PEST.**—This insect is not a native of the United States but appears to have been brought here from China where it occurs commonly upon native food plants. It was introduced into the San Jose Valley, California, about 1870 and the name of that locality where it was first found has been adopted as the common name of the scale. From California the species was brought on nursery stock into the eastern states shortly before 1893. It has since been spread by nursery stock shipments until it now occurs in nearly every State in the Union. During recent years, however, most of the States have passed strict laws requiring the inspection of nurseries for the occurrence of the scale and the fumigation of stock so as to kill any scales which might possibly exist there before the stock can be legally sold and distributed. The nurserymen have co-operated heartily in this effort to prevent the further spread of the pest so that now the buyer of fruit trees is very effectually protected against the planting of already infested trees. Orchards may be started today much more safely than they could ten years ago.

**OCCURRENCE OF THE SCALE IN ALABAMA.**—The known extent of its occurrence in this State is indicated upon the accompanying map (Fig. 1.). Without doubt it exists in many other places from which it has not yet been reported. Very frequently its presence in an orchard is not detected until some of the trees begin to die whereupon the cause of their death is sought for. A characteristic type of peach tree dying from this scale is shown in Plate I, fig. 1. The dying of the trees does not usually begin until some two or three years after the actual introduction of the scale and it has thus an opportunity to spread unchecked through the orchard.

**WHAT IS THE SCALE.**—The San Jose scale is a minute, inconspicuous insect which does not, to the untrained observer, appear to be a living creature. The body of the living insect is concealed beneath the circular, waxen scale which it forms for its protection. The largest scales



are smaller than an ordinary pin-head in diameter and are quite flat (See Pl. I, figs. 2 and 3). The scales are hardly more than 1-25 inch across and many of them are smaller still. Beneath the scale the body of the insect may be found as a small, immovable, yellow body (if still alive) which if crushed seems to be filled with a rather thin, yellow, oily liquid. The young of this species are born alive and their powers of reproduction are so remarkable that a tree bearing but few live scales in the Spring may become quite heavily infested by Fall and will then be liable to severe injury during the following season unless some method of destroying the scales is used during the winter.

Close observation with the naked eye shows that the scales are marked with rings of light and dark gray around a nearly black center. When very abundant they give a general ashy-gray appearance to the entire bark which is noticeable at some distance from the tree.

**NATURE OF THE INJURY.**—On living infested branches, especially on growth two or more years old, the surface becomes irregularly pitted or has depressions in spots where the scales are most abundant. The injury is of two kinds. Much sap is abstracted by the myriads of sucking insects, but more important than this is the effect which these scales have of causing a thickening of the cell walls which are penetrated by their slender mouth parts. This thickening checks the flow of sap in the branches, and this means the ultimate starvation of the parts of the branch beyond. The San Jose produces a distinctive red stain around the point of attack, either upon infested fruit or just under the scale in the bark. This appears upon lightly scraping off the outer bark.

**NECESSITY FOR TREATMENT.**—So serious is the injury of which this scale is capable that untreated, infested trees are certain to be killed within a very few years. The **LIFE OF THE ORCHARD IS AT STAKE** and the plain conclusion is evident that it is far more expensive to allow the trees to be destroyed than it would be to con-

trol the scale which can positively be done so as to continue the life of the orchard and the production of profitable crops. The average annual cost per tree for treatment depends mainly upon its size and ranges, for peach trees, from one-half cent to three cents, averaging between one and two cents. The man who will allow his total investment in trees, land and labor through three or four years to be absolutely destroyed for lack of an additional expense of a cent or two per tree each year, cannot be considered as conducting his work upon anything like business principles.

**BEST METHOD OF TREATMENT.**—The fight against the San Jose scale has developed several methods of treatment which are of positive value. Three points require consideration in determining which of these methods is best and should therefore be used. 1. Safety. 2. Efficiency. 3. Economy. The method which has been shown to best fulfill these conditions is "A WINTER SPRAYING WITH LIME-SULFUR WASH." In spite of numerous efforts to replace this Lime-Sulfur with some other material more easily prepared or less objectionable to handle in application, the fact remains that this is conceded by the great majority of orchardists, as well as by entomologists, to be the best treatment yet found.

It may be applied with safety at any time while the trees are in a dormant condition. A single thorough spraying with a properly prepared wash insures the control, if not the extermination, of the scale and is safer and more reliable than is any other treatment. The cost of treatment, varying in localities and with number of trees to be treated, need not exceed from one to thirty cents per tree according to their kind and size

**SEASON FOR MAKING THE APPLICATION.**—The safest and most effective time for treating trees for scale is during the dormant period, that is, between the time the leaves drop in the fall and the time the buds start in the spring. Experimental work has shown that a single treatment with Lime-Sulfur made in November or De-

cember is less effective than is a single treatment made in February or March, and that two treatments, one in the Fall and another just before the buds start, are but slightly more effective than is the later treatment alone. The exact time for spraying after January 1st may be decided by convenience as related to other work and by the continuance of the dormant condition of the buds.

A solution strong enough to kill the scale may be applied to the bark without injury at any time during the summer. It may be applied by painting or swabbing it onto the trunks and largest branches to check the summer development of the scale, but such a solution will destroy all foliage touched by it, and cannot therefore be sprayed on as in winter.

At about one-fifth of the strength recommended, however, it is thought by some that Lime-Sulfur can be sprayed upon even peach foliage which is fairly matured as at fruiting time, and that at that strength it will be a very effective agent in the prevention and control of the brown rot of peaches which is now one of the most serious problems in peach production in Alabama.

**PREPARATION ON THE ORCHARD FOR TREATMENT.**—This is a matter of considerable importance and the exact measures to be applied to each tree depend largely upon the degree of its infestation.

Slightly infested trees should be pruned before being treated as is best for their fruiting regardless of the presence of the scale. With heavily infested and badly injured trees, the pruning should be much more thorough. Trees which are nearly dead should be cut out and, in a young orchard, replaced if desired by new ones. All dead branches should be removed. Branches still alive but which have made very little growth during the preceding season should be strongly cut back, in some cases leaving them as mere "stubs" a foot or two long from the main trunk. If the cuts are more than three-fourths of an inch in diameter their surfaces should be painted over with White Lead. If there is still life enough in the tree

a new top may be formed out of several of the best and most vigorous shoots thrown out from these "stubs." In many cases it may be possible to control the scale and to thus renew the top of badly injured trees, so as to have them again of good size and bearing more fruit in two or three years than would young trees if put in their places. This is entirely a question of orchard management for the quickest and best production of fruit. It is certain that the scale may be controlled so the age and condition of the tree, etc., must decide the question whether it should be pruned and kept or cut out. It is advisable to burn removed trees and branches to get them out of the way and to prevent further spread of insect pests from them to living trees. The scale is not liable to spread if the trees and prunings are not burned but other injurious insects which may breed in the dead wood may spread from them, particularly to scale injured trees and thus cause the death of trees which might otherwise be saved from the scale.

Adjacent thickets or trees of wild plums or cherry, etc., should be cut and burned. Beside the trees mentioned many others are liable to attack by this scale. The following are some of those occurring commonly: Crab apple, apricot, persimmon, several kinds of walnut and of poplar, osage orange, chestnut, sumac, catalpa, cedar, several of the willows, ash, elm, pecan, orange, lemon, strawberry, gooseberry, currant, etc.

**THE LIME-SULFUR TREATMENT.**—This wash has been very extensively used in California during the past twenty years. In the eastern United States since about 1900 it has been recognized as the best agent for destroying San Jose scale. Its effectiveness depends upon a chemical combination of the lime and sulfur which is brought about practically only under high temperatures. In a general way, if the chemicals are pure, we may reckon upon using practically equal portions of lime and of sulfur. In practice, however, it has been found better to use a somewhat larger quantity of lime, since commer-

cial rock lime varies somewhat in purity and is cheap. The excess of lime simply forms a whitewash which shows plainly the trees that have been treated. An excess of sulfur would remain undissolved in the solution. While this would do no harm, its presence would do no good and it might be considered as a needless item of waste. Both lime and sulfur are effective for some insects and fungi when used separately, but when combined they act far more efficiently. The principal object in making the wash is to produce economically a safe and thoroughly effective spraying solution.

In planning for making and using this wash a number of practical points require consideration for best results.

**ESTIMATION OF QUANTITIES OF CHEMICALS NEEDED.**—Naturally this is a difficult matter for the man who has never used anything of the kind. The first consideration is the number and the average size of the trees to be treated. If the scale is known to occur anywhere in an orchard, the only safe thing to do is to spray all trees in it, and the treatment should include at least all of our fruit trees which shed their leaves in the Fall. The amount of spray required will obviously depend directly upon the size of the tree. We may take average three to four-year-old peach trees as our standard and estimate that such trees will require about one-half gallon of spray each for thorough work, and no other kind of work is worth while. Each gallon of spray solution will therefore treat two medium-sized trees, while large trees may require two gallons each. In this way an approximate estimate may be made of the number of gallons of spraying solution to be prepared.

The question of formula must be next considered. As a result of a vast amount of experimental and practical work, it appears that the following formula is safe, efficient and economical:

Rock lime .....	20 lbs.
Flowers of Sulfur or Sulfur Flour.....	15 lbs.
Water to make.....	50 gallons

In ordering our chemicals therefore we reckon upon 20 lbs. of lime and 15 lbs. of sulfur for every 50 gallons of spraying solution which we have estimated to be needed. Emphasis should be laid upon the ultimate economy of using only the best and purest chemicals obtainable, regardless of their slightly greater initial cost.

**LIME.**—This means always freshly burned rock lime or quick lime. The test of quality is the slaking. Good limes should not contain more than ten per cent of impurities. Poor limes may contain 25 per cent of impurities. It is partly on account of these varying percentages of impurities that more lime than sulfur is used in the formula given. A good lime will slake readily and form an even creamy solution with little sediment or coarse matter which is waste.

Much first-class lime is produced in Alabama, particularly that made in the vicinity of Calera. The addresses of several manufacturers may be found in the Appendix on page 20.

The best grade of lime is shipped and handled in barrels. This is the best form in which to buy it, and the cost should not exceed about \$1.00 per barrel or 1c per pound for our spray formula. In nearly every town may be found someone who handles a good grade of lime.

**SULFUR.**—The sulfur used must be very finely powdered to combine readily and completely with the lime in the making of the wash. Two forms of sulfur to be found on the market are perfectly pure and answer this need equally well. The "Flowers of Sulfur" is the finest form and is largely used, but may cost slightly more than does "Sulfur Flour" or "Flour Sulfur" as it is called. The choice between these two depends upon availability and price. Either should be obtainable at about five cents per pound in lots of fifteen pounds or more. If not obtainable at a satisfactory price through local druggists, sulfur may be secured through the wholesale drug firms listed in the Appendix page 20, and from other firms probably as well. Crystalline Sulfur should not be used under any

circumstances, since it is so coarse that it will not combine completely with the lime even with prolonged boiling. The result is a direct waste of sulfur and a wash solution that is liable to contain too little sulfur to be efficient, thus wasting all the chemicals, the labor of application and possibly, too, the life of the trees through ineffective treatment.

**PREPARATION OF THE WASH.**—For this work some facility for boiling the solution is essential. Where it is to be made on a small scale, and even in the treatment of several thousand trees where only one barrel pump is to be supplied, the cooking may be done quite conveniently in two large cast iron kettles, one of which may hold about 20 to 25 gallons, while the other should hold 40 gallons. The smaller kettle can be used in heating water while the lime and sulfur are being boiled in the larger one. For treatment of from 5,000 to 10,000 trees it is better to have larger kettles holding 75 to 80 gallons and mounted in a brick frame work or furnace. The cooking should be done when possible near a convenient water supply, but it is better to haul the water than the wash. For more than 10,000 trees it will be far better to cook the wash by steam supplied directly from a portable boiler or some such source. the cooking may then be done in barrels placed side by side and preferably upon an elevated platform. The essential point is that the boiler supply about one horse power for each barrel to be boiled with about 30% surplus power for the pumping and heating of water, etc. Wherever possible the water supply and the cooking barrels should be elevated sufficiently to utilize gravity in the flow of the liquids into the cooking barrels and from them into the spray tanks.

( The kettle method of preparation will be described particularly as it may be more commonly employed in this State. Much latitude is permissible in the details of the preparation for the cooking. The essential points are to secure the complete and rapid slaking of the lime and the mixture of the sulfur with the lime solution without the

lumping of the sulfur. To avoid this the sulfur should always be mixed to a thin paste with hot water before being poured into the large boiling kettle. If this be done it makes little difference in the final result whether it be added before, after or during the slaking of the lime. The following method is as good as any and easy to follow:

For each 50-gallon lot of spray solution to be prepared mix 15 lbs. of fine sulfur to a thin paste in hot water in some convenient receptacle. Heat about 12 to 15 gallons of water in the 40-gallon kettle and while it is heating add the sulfur paste taking care to break up any lumps that may exist. Then add, lump by lump, the 20 lbs. of best rock lime. By the time the lime is all slaked the solution should be boiling hot. Add about 10 gallons more of hot water and continue the boiling steadily for about one hour. During this time the mixture must be stirred almost constantly to keep it from burning and to insure the complete solution of the sulfur. When properly prepared there should be no residue of sulfur after this cooking. The wash will appear as a rather thick, reddish brown, or dark orange-colored liquid. It gives off a strong odor of sulfur and is caustic in its action. Impurities in the lime may vary the color of the liquid, as does also the excess amount of lime but a variation in color need not affect its efficiency if the wash has been properly stirred and boiled.

From the boiling kettle the wash goes to the spraying barrel into which it should be strained through a brass strainer having about 20 meshes per inch. See fig. 2. This may be purchased or made at home. The strainer should remove all impurities which might clog the nozzles and delay the work in spraying. Never strain the wash through burlap bagging as the lint from the bagging will soon clog the pump. In the barrel the wash may be finally diluted with cold, but preferably with hot, water to make the required 50 gallons of spraying solution. The amounts of lime and sulfur may be varied,



still keeping the proportion between them, in preparing larger or smaller quantities of the wash as may be needed. In general it is better to spray the wash while it is still



Fig. 2.

warm or quite hot. It works easier in the pump and by the time the spray reaches the tree it is cooled so that there is no danger of its doing injury. It is generally considered as desirable to use the wash upon the day it is prepared but this does not seem to be absolutely necessary. Undiluted wash standing till cold will crystalize but the crystals may be again dissolved by reheating thoroughly and the wash is then probably just as good for use as ever.

**SPRAYING OUTFIT.**—While it is possible to apply the wash by painting or swabbing it onto the trunks and larger branches, the smaller branches and twigs cannot be thoroughly treated in this way and this method of application is so wasteful of time and materials that it will be found more economical as well as efficient to do the work with a "bucket pump" such as may be bought for about \$6.00. This may serve fairly for the treatment of from 25 to 50 trees if they are small but for large trees,

or more of them, every orchardist should have a "barrel pump." These may be had in different sizes and full de-

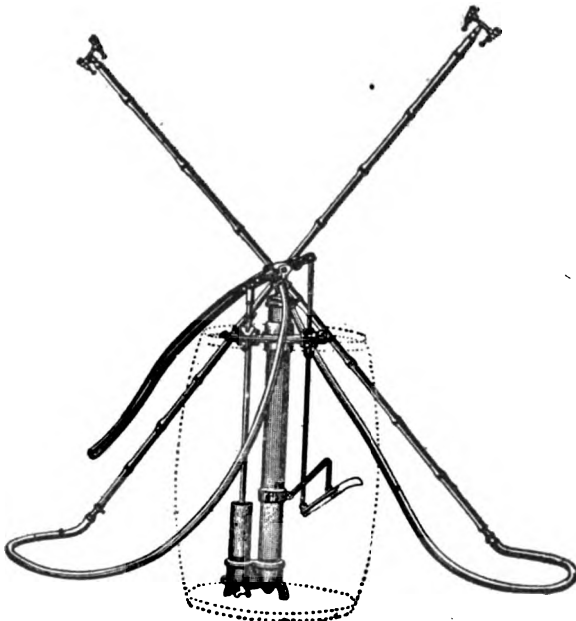


Fig. 3.

scriptions may be found in the catalogs of the various dealers whose addresses are given in the Appendix on page 20-21.

In selecting an outfit for Lime-Sulfur work it is essential that all of the working parts of the pump be of brass and that there be no leather packings or valves. The caustic action of the wash soon corrodes copper and destroys leather but affects brass only slowly. The best apparatus is the cheapest in this case. The most economical outfit for the average orchardist is a barrel pump that is powerful enough to carry two lines of hose with strong pressure for four nozzles. (See fig. 3).

The barrel in which the pump is mounted may well be an ordinary 50-gallon oil barrel such as may be obtained in any town and the mounting of the pump is a simple

operation. The hose should be one-half inch in diameter, inside measure, and of at least four-ply stock. Such hose may be secured of some of the firms mentioned at from 12 to 15 cents per foot. The best hose is not liable to burst under the pressure from the pump and will last much longer than cheaper grades. The length of hose usually furnished by manufacturers with their pumps is too short for satisfactory use. About 25 feet is a good working length for each line as it allows the sprayers more range and insures more rapid and more thorough work which more than offsets the slight extra cost for the longer hose. Each line should be provided with an extension rod from 6 to 12 feet long according to the size of the trees to be treated. There should be two "cut-offs" for each line of hose: one between the pump and the hose and the other between the hose and the extension rod. These save time and liquid and it is more economical to have them than to work without them.

The kind of nozzle to be used is a very important matter. That throwing the best spray is known as the "double Vermorel." There are several types of this nozzle made by various manufacturers which accomplish very similar results. One of these is shown in fig. 4. The

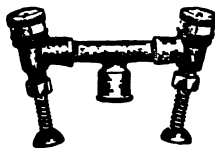


Fig. 4.

nozzle should be provided with plungers to clean them when they become clogged as is liable to happen occasionally even if the wash has been properly strained. The nozzle caps for Lime-Sulfur work should have an opening of 1-16 inch and extra caps should be kept on hand to replace old ones when they become worn so that they throw too coarse a spray. The pressure from the pump should be kept *strong* and especially when four nozzles

are being supplied care must be exercised to see that the pumper does not take his work too easily. The barrel outfit may be carried through the orchard in any kind of a one-horse wagon or on a drag. The driver does the pumping while a man is needed on the ground for each line of hose.

A thoroughly good outfit such as has been described will cost about \$25.00 and with proper care it should last for a number of years. It will serve equally well in the application of all arsenical poisons for leaf and fruit feeding insects or for those attacking many of the garden or field crops. It may also be used for whitewashing. Altogether such an outfit is one of the most profitable pieces of equipment that any orchardist can own. Its intelligent use will go farther toward the production of *profits* with almost any crop than can any equal expenditure made in other ways without the spraying.

Information regarding "power sprayers" may be had from the catalogs of manufacturers and suggestions regarding them will be gladly given anyone upon application to the Entomologist, Alabama Experiment Station, Auburn, Ala.

**SPRAYING SUGGESTIONS.**—While much in regard to spraying can be learned only from experience, there are many suggestions that may be of aid to the beginner.

Only the most careful work is worth doing at all. Care should be taken to cover the twigs and small branches as thoroughly as the larger branches and trunks. If the tree is completely dormant, heavy drenching with the wash will not injure it and it is better to use more spray than is really needed than to use too little to do the work thoroughly. Do not undertake to spray when the prospects are for an immediate storm or severe cold spell since if these should occur before the wash has dried thoroughly on the trees the work will have to be repeated to be effective. Good work cannot be done when a strong wind is blowing. Select fair, calm weather for the work whenever possible or else make a second treatment when it is

calm or when the wind is blowing from the opposite direction to that during the first spraying. The spray solution must be continually agitated during the spraying and a properly constructed pump will accomplish this.

The disagreeable effects of getting the wash on the skin may be reduced by rubbing the hands and face with vaseline before spraying. Rubber coats and gloves are, of course, the best protection for the sprayers but if not available old clothes should be worn so that they may be discarded after the work is finished. Cheap canvas work gloves are a satisfactory protection for the hands. The mules, or horses, and the harness may well be protected by blankets made of old burlap sacks.

After the days work is over the remaining solution should be drawn or emptied out and clear water run through the pump, hose and nozzles to leave them in clean condition and reduce the corrosive injury to the outfit which would otherwise be as great through a night of standing as through a day of use. This cleaning should be particularly thorough at the end of each seasons work or when the apparatus is to be stored for any length of time. All working parts should be kept thoroughly oiled. These measures of care will reduce the expenses for repairs and improve the ease and quality of the work done.

**GENERAL USEFULNESS OF LIME-SULFUR WASH.**—Its superior power of controlling the San Jose scale is but one of the many advantages of this wash. It adheres to the trees for a long time and its good effects are continued through several months after the application. It acts both as an insecticide and also as a fungicide.

As an insecticide it is effective for nearly all of the scale insects occurring upon fruit trees. It destroys the winter eggs of the plant lice which attack the leaves and twigs of apple so abundantly in the Spring. It also controls the "pear-tree Psylla" and the "pear-leaf blister mite" as well as the "silvering mite" of the peach and the "peach-twig borer."

At the same time as a fungicide it is exceedingly effec-

tive against the "peach-leaf curl" and the "brown rot," also for the "apple scab" and "pear scab" and other fungous diseases of fruits.

These fruit pests cannot all be reached at the same time with any other of the numerous methods of treatment which are sometimes substituted for the Lime-Sulfur for controlling the San Jose scale. No other insecticide now known can equal in range of usefulness and in economy a single thorough application of Lime-Sulfur wash to fruit trees just before the buds start in the Spring.

Manifestly these important considerations in favor of Lime-Sulfur far outweigh all contrary ones based upon the inconvenience in its preparation and the disagreeableness of handling and applying it. To obviate the objections to the preparation of the wash any one who desires may now buy it in a concentrated solution ready to dilute directly with water for spraying. It is sold by several of the manufacturers of insecticides whose addresses are given in the Appendix on page 21-22. This might be particularly desirable for the man who needs but little of the wash. The commercial article has shown up favorably in experimental tests but apparently has no superiority in effect over the home-made article which, of course, costs somewhat less.

**DETERMINATION OF SPECIMENS AND SPECIAL ADVICE.**—Specimens suspected of being San Jose scale, and any other insects attacking fruits, trees, garden and field crops, etc., may be submitted to the Entomologist, Alabama Experiment Station, Auburn, Ala., for determination. They should be mailed in a tight, strong box bearing plainly on the outside the name and address of the sender and separate from the letter of advice which should describe as fully as possible the nature and extent of the injury which the insect seems to be doing. The Entomologist will gladly and freely give any suggestions possible for combating insect pests thus brought to his attention.

## APPENDIX

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### INSECTICIDE MATERIALS AND SPRAYING APPARATUS: ADDRESSES OF DEALERS AND MANUFACTURERS.

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Believing that much of the failure to adopt recommendations for spraying treatment for insect and fungus pests is due to a lack of definite knowledge as to just where reliable materials and equipment may be secured, we give below the addresses of some of the many firms manufacturing or dealing in insecticide materials and apparatus. In doing this we do not mean to imply that other dealers do not make or handle just as reliable and satisfactory goods. Those listed may be depended upon and are as accessible as possible to the people of Alabama.

#### LIME WORKS.

Newala Lime Works, Calera, Ala.  
Calera Lime Works, Calera, Ala.  
Keystone Lime Works, Calera, Ala.  
Longview Lime Works, Calera, Ala.

#### WHOLESALE SULFUR DEALERS.

Durr Drug Co., Montgomery, Ala.  
Greil Bros., Montgomery, Ala.  
Jacob's Pharmacy, Wholesale Department, Atlanta, Ga.  
Mobile Drug Co., Mobile, Ala.

#### SPRAYING MACHINERY.

Morrill and Morley, Benton Harbor, Mich. (Local agency G. W. Barnett Hardware Co., Montgomery, Ala.)

Goulds Mfg. Co., Seneca Falls, N. Y. (Goods handled by Beck & Gregg Hardware Co., Atlanta, Ga.; Alabama Machinery & Supply Co., Montgomery, Ala.)

The Deming Co., Salem, Ohio. (No local agency so far as we know.)

Frost Insecticide Co., Arlington, Mass. (No local agency.)

Dayton Supply Co., Dayton, Ohio. (Agency with Macon Implement Co., Macon, Ga.; Alabama agencies are being established also.)

F. E. Myers & Bro., Ashland, Ohio. (Agencies with Barney-Cavanaugh Hardware Co., Mobile, Ala.; Selma Hardware Co., Selma, Ala.; and Alabama Machinery & Supply Co., Montgomery, Ala.)

#### INSECTICIDE MANUFACTURERS AND DEALERS.

Graselli Chemical Co., Birmingham, Ala. (Make and sell Lime-Sulfur solution, Arsenate of Lead, Bordeaux mixture, etc.)

Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Sell a number of kinds of specially prepared insecticides.)

Frost Insecticide Co., Arlington, Mass.

Rex Co., Omaha, Nebraska. (Sell Lime-Sulfur solution and Arsenate of Lead particularly.)

Thomsen Chemical Co., Baltimore, Md. (Sell Lime-Sulfur solution.)

Fred. L. Lavanburg, 100 William St., New York, N. Y. (For Paris Green and Arsenate of Lead particularly.)

Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Makers of Swift's Arsenate of Lead.)

Adler Color & Chemical Co., New York, N. Y. (Make Paris Green, Arsenate of Lead, etc.)

Acme Color Works, 100 William Street, New York, N. Y. (Paris Green, etc.)

A. B. Ansbacher & Co., New York, N. Y. (Paris Green, etc.)



F. W. Devoe & Co., New York, N. Y. (Paris Green, etc.)

Leggett & Brother, New York, N. Y. (Various insecticides.)

Sherwin-Williams Co., Newark, N. J. (Paris Green.)

American Horticultural Distributing Co., Martinsburg, W. Va. ("Target Brand" insecticides.)

B. G. Pratt Co., 11 Broadway, New York, N. Y. (Scalecide.)



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BULLETIN NO. 145

FEBRUARY, 1909

**ALABAMA**  
**Agricultural Experiment Station**  
**OF THE**  
**Alabama Polytechnic Institute**  
**AUBURN.**

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**Local Fertilizer Experiments With Cotton**  
**in 1895, 1896, 1897 and 1898**

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**BY**  
**J. F. DUGGAR, Director.**

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**Opelika, Ala.:**  
**The Post Publishing Company,**  
**1909**

## COMMITTEE OF TRUSTEES ON EXPERIMENT STATION.

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# LOCAL FERTILIZER EXPERIMENTS WITH COTTON IN 1905, 1906, 1907, AND 1908.

By J. F. DUGGAR.

For a number of years this Station has conducted numerous local fertilizer experiments, furnishing material and instructions to farmers agreeing to make the tests.

The number of local fertilizer experiments with cotton, of which reports were received, was as follows: In 1905, ten; in 1906, thirteen; in 1907, ten; and in 1908, twenty-two. This does not include a number of experiments begun and not successfully completed. In all of these years fertilizer experiments were also made on corn and other crops, the results of which will be published later.

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of Alabama.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.

The following list gives the name and address of each experimenter who has reported the results of fertilizer experiments made under our direction during the past four years, with page of this bulletin where the results may be found.

COUNTY.	POST OFFICE	NAME.	DATE.	PAGE
Autauga	Prattville	J. W. Young	1905-6	49-52
Barbour	Louisville	J. D. Veal	1906	69
Blount	Tidmore	Jno. W. Staab	1905	39-42
Bullock	Union Spr'gs	F. B. Haynes	1908	78
Bullock	Three Notch	A. M. Cope	1906	68-69
Bullock	Suspension	O. M. Hill	1906	78
Chambers	Fredonia	E. W. Smartt	1905	78
Chilton	Verbena	G. H. Caffey	1907-8	49-50
Chilton	Verbena	J. H. Willoughby	1905-6-8	47-49
Conecuh	Betts	R. H. Betts	1905-6-7	75-76
Cullman	Cullman	L. A. Fealy	1906	39-42
Cullman	Joppa	O. G. Roberts	1906-7-8	39-40
Fayette	Newtonville	J. B. Gibson	1906-7-8	45-47, 78
Franklin	Russellville	T. J. Willis	1905-6	29-30
Geneva	Geneva	M. P. Metcalf	1905	69-70
Greene	Eutaw	W. W. Morgan	1908	48
Henry	Headland	W. F. Covington	1907-8	73
Henry	Columbia	T. Z. Atkeson	1908	71-73

COUNTY	POST OFFICE	NAME	DATE	PAGE
Lauderdale	Florence	W. A. Parish	1905-6	30-31
Lauderdale	Florence	J. W. Haddock	1907-8	30-32
Lawrence	Hillsboro	F. T. Nealy	1905	35
Lee	Auburn	Ala. Expt. Station	1905-6	59
Lee	Auburn	Jno Jackson	1908	57-58
Lee	Bee Hive	T. W. Cox	1905-6	58
Macon	Notasulga	S. C. Jackson	1905	61-64
Macon	Shorter	Y. Swearington	1906	61-65
Macon	Society Hill	Robt. Floyd	1806-7	66
Macon	Hurtsboro	A. B. Floyd	1908	66
Madison	Huntsville	H. D. N. Wales	1905	33-35
Marengo	Faundsdales	W. C. McNight	1905	53-54
Marion	Hamilton	6th Dist. Agr. School	1906	39-42
Morgan	Hartselle	J. O. Burleson	1907-8	35-36
Montgom'ry	Montgomery	J. M. Jones	1906-7	54
Montgom'ry	Montgomery	T. M. Oliver	1907	52-56
Montgom'ry	Naftel	W. C. Naftel	1905	78
Pickens	Gordon	D. W. Davis	1906	78
Tallapoosa	Notasulga	M. E. Parker	1907	59
Tallapoosa	Notasulga	E. B. Jackson	1907	61-63
Tallapoosa	Notasulga	J. W. Parker	1907	61-62
Walker	Cordova	J. L. Alexander	1908	39-44
Winston	Nauvoo	W. M. Omary	1908	39-43

The directions stated that land employed for this test should be level and uniform, not manured in recent years, not in cowpeas the preceding year, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of standard treatment for all plots (except as to kind of fertilizer used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled before planting.

#### THE RAINFALL.

The following data are taken from the records of the Alabama section of the Weather Bureau, and show the average rainfall for the state:

	INCHES RAINFALL.				
	1905	1906	1907	1908	
January	5.26	4.66	2.20	4.28	.....
February	7.24	2.39	5.04	6.30	.....
March	3.70	9.26	2.94	4.77	.....
April	3.69	1.03	6.26	5.84	.....
May	5.51	4.63	7.94	5.34	.....
June	4.56	3.45	2.85	2.75	.....
July	4.56	8.50	5.00	4.72	.....
August	5.30	3.78	3.50	3.44	.....
September	2.51	8.44	5.50	2.42	.....
October	4.39	3.54	1.44	1.76	.....
November	1.78	2.50	6.15	1.52	.....
December	6.46	4.19	6.01	5.02	.....
<b>Average</b>	<b>55.38</b>	<b>56.56</b>	<b>54.66</b>	<b>48.16</b>	<b>.....</b>
<b>Average yearly normal</b>	<b>.....</b>	<b>.....</b>	<b>.....</b>	<b>.....</b>	<b>51</b>

### THE FERTILIZERS USED.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available) -----	\$14.00
Cotton seed meal -----	25.00
Kainit -----	15.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above.

In each experiment two plots were left unfertilized, these being plots 3 and 8. When these yields differed widely the experiment was classed as inconclusive. The increase on plots 4 to 7 is calculated on the assumption that the graduation in fertility is uniform from plot 3 to plot 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos.

### PRICE ASSUMED FOR SEED COTTON.

The price assumed is \$14.00 per ton for seed, and 10 cents per pound for lint, a price found by averaging prices of 9, 11, 11, and 9 cents per pound respectively, for the crops of 1904, '5, '6, '7, and '8. This is equal to 3.8 cents per pound of seed cotton turning out  $33\frac{1}{3}$  per cent. of lint. Deducting  $\frac{6}{10}$  cents per pound as the average cost of picking and ginning, and we have left 3.2 cents as the net value per pound of the increase of seed cotton due to fertilizers. This latter is the figure used in all financial calculations.

*Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.*

Plot No.	Amount per acre.	FERTILIZERS	MIXTURE CONTAINS			COST OF FERTILIZERS	
		KIND	Nitrogen	Available phosphoric acid	Potash.	Per ton	Per acre
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>		
1	200	Cotton seed meal .....	13.58	5.76	3.54	\$25.00	\$2.50
		<i>In 100 lbs. c. s. meal.*</i>	6.79	2.88	1.77		
2	240	Acid phosphate .....		36.12		14.00	1.68
		<i>In 100 lbs. acid phos.</i>		15.05			
4	200	Kainit .....			24.60	15.00	1.50
		<i>In 100 lbs. kainit.</i>			12.30		
5	200	Cotton seed meal .....	13.58	41.88	3.54	18.99	4.28
	240	Acid phosphate .....					
		<i>In 100 lbs. above mixt.</i>	3.09	9.52	.80		
6	200	Cotton seed meal .....	13.58	5.76	28.14	19.50	4.00
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	3.39	1.44	7.03		
7	240	Acid phosphate .....				14.45	3.18
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>		8.21	5.59		
9	200	Cotton seed meal .....	13.58	41.88	28.14	17.81	5.68
	240	Acid phosphate .....					
	200	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	2.12	6.54	4.39		
10	200	Cotton seed meal .....	13.58	41.88	15.84	18.24	5.93
	240	Acid phosphate .....					
	100	Kainit .....					
		<i>In 100 lbs. above mixt.</i>	2.59	7.75	2.93		

\*Average of many analysis.

†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by  $1\frac{8}{14}$

FRANKLIN COUNTY, 5 MILES NORTH-WEST OF RUSSELLVILLE.  
T. J. WILLIS. 1905-6, (See Table, p. 30.)

*Dark gray sandy soil, with light colored clay subsoil.*

These tests were made on a hilltop which had been in cultivation about 10 years. The forest growth was hardwoods.

It is evident that this soil responded freely to every fertilizer, whether applied singly, by twos, or all three together.

In both years a complete fertilizer (plots 9 or 10) was the most profitable application, closely followed in yield and profit by a mixture of acid phosphate and cotton seed meal. On plot 9 the complete fertilizer increased the yield by 1000 and by 792 pounds of seed cotton. After deducting the cost of the fertilizer (p 29) this left profits of \$26.32 and \$19.66 per acre. Phosphate was most effective, cotton seed meal next, and kainit least, but still useful.

	1905	1906
	Lbs. Lbs	
<i>Average yield of seed cotton, unfertilized.....</i>	352	376
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	192	24
To acid phosphate plot .....	172	120
To kainit plot .....	204	144
To acid phosphate and kainit plot.....	167	176

<i>Average increase with cotton seed meal.....</i>	184	116
--	-----	-----

Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	664	456
To cotton seed meal plot .....	644	552
To kainit plot .....	739	600
To cotton seed meal and kainit plot .....	702	632

<i>Average increase with acid phosphate .....</i>	687	560
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Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	94	16
To cotton seed meal plot .....	106	136
To acid phosphate plot.....	169	160
To cotton seed meal and acid phosphate plot.....	164	216

<i>Average increase with kainit .....</i>	133	132
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*Experiment at Russellville (Franklin Co.) and near Florence (Lauderdale Co.) 1905-6-7-8*

FERTILIZER	T. J. WILLIS Russellville 1905		T. J. WILLIS Russellville 1906		J. W. PARISH Florence 1905		W. A. PARISH Florence 1906		J. W. HADDOCK Florence 1907		J. W. HADDOCK Florence 1908	
	Amount per acre	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	
KIND	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	
200 Cotton seed meal....	520	192	400	24	604	336	408	232	672	72	910	460
240 Acid phosphate....	992	664	832	456	664	392	368	192	1032	432	650	200
No fertilizer.....	327	.....	376	.....	272	.....	176	.....	600	.....	450	.....
200 Kainit.....	432	94	392	16	608	308	352	179	1424	848	800	340
200 Cotton seed meal....	1184	836	952	576	1184	857	608	438	1840	1288	1550	1080
200 Acid phosphate....	656	298	536	160	960	606	320	153	1256	728	1010	530
200 Cotton seed meal....	1200	833	992	616	920	539	456	293	.....	.....	710	220
240 Acid phosphate....	376	.....	376	.....	408	.....	160	.....	480	.....	500	.....
No fertilizer.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
200 Cotton seed meal....	1376	1000	1168	792	816	408	544	384	1208	728	1100	600
240 Acid phosphate....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
200 Kainit.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
200 Cotton seed meal....	1408	1032	896	520	824	416	528	368	872	392	980	480
240 Acid phosphate....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
100 Kainit.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

## LAUDERDALE COUNTY, 10 MILES WEST OF FLORENCE.

W. A. PARISH, 1905-6. (See Table, p. 30.)

*In 1905 stiff light gray soil with red subsoil; in 1906 darker soil, with red clay subsoil.*

Both fields had been cleared for 30 or 40 years. The original forest trees are said to have been post oak, red oak, black oak, and hickory. Every fertilizer considerably increased the yield in both years. In both years the largest increase, 857 pounds and 438 pounds of seed cotton respectively, was afforded by plot 5, fertilized with a mixture of cotton seed meal and phosphate. This represents a net profit of \$23.14 and \$9.73 per acre. In 1904 a test made by Mr. Parish on gray soil with reddish subsoil showed an average increase attributable to cotton seed meal of 249 pounds of seed cotton per acre; an increase due to acid phosphate of 584 pounds; and an increase due to kainit of 212 pounds of seed cotton. This indicated a need for the complete fertilizer, while the later tests gave good results without kainit.

It seems that this soil needs chiefly phosphoric acid, but that this should usually be supplemented by nitrogen. The soil on which both Mr. Parish and Mr. Had-dock made their experiments was that known locally as "The Barrens," and described in soil survey reports as "Clarksville Silt Loam."

	1904	1905	1906
<i>Average yield of seed cotton per acre, unfertilized.</i>	452	340	168
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot .....	284	336	232
To acid phosphate plot .....	269	465	246
To kainit plot .....	237	298	—26
To acid phosphate and kainit plot .....	203	131	91
<i>Average increase with cotton seed meal .....</i>	249	242	138

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	696	392	192
To cotton seed meal plot .....	681	521	206
To kainit plot .....	494	231	114
To cotton seed meal and kainit plot .....	465—198		231
<i>Average increase with acid phosphate .....</i>	<i>584</i>	<i>236</i>	<i>188</i>

Increase of seed cotton per acre when kainit was added:

To unfertilized plot.....	334	308	179
To cotton seed meal plot.....	287	270	--79
To acid phosphate plot .....	132	147	101
To cotton seed meal and acid phosphate plot .....	71—449		—54
<i>Average increase with kainit .....</i>	<i>212</i>	<i>69</i>	<i>37</i>

LAUDERDALE COUNTY, 10 MILES WEST OF FLORENCE.

J. W. HADDOCK, 1907-8. (See Table, p. 30.)

*Gray soil, with red subsoil.*

This field had been cleared about 40 years, and was of the same character as soil used in Mr. Parish's experiment. The stand was uniform. The results both years agree with Mr. Parish's experiments in showing that the most effective fertilizer was a mixture of acid phosphate and cotton seed meal, the phosphate being more important. It is curious and inexplicable that kainit when applied alone gave a large increase, but when combined with either or both of the other fertilizers it gave little or no increase. These tests, though presenting some figures that cannot be understood, confirmed the conclusions drawn from Mr. Parish's tests, namely, that acid phosphate is most important, that it should be supplemented by cotton seed meal, and that potash is generally unnecessary.

	1907	1908
	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	540	475
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	72	460
To acid phosphate plot .....	856	880
To kainit plot .....	—120	190
To acid phosphate and kainit plot .....		380
<i>Average increase with cotton seed meal</i> .....	269	478

Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	432	200
To cotton seed meal plot .....	121	620
To kainit plot .....		—120
To cotton seed meal and kainit plot .....	0 0	70
<i>Average increase with acid phosphate</i> .....	576	193

Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	848	340
To cotton seed meal plot .....	656	70
To acid phosphate plot .....		20
To cotton seed meal and acid phosphate .....	—560	—600
<i>Average increase with kainit</i> .....	315	—43

#### MADISON COUNTY, 5 MILES WEST OF HUNTSVILLE.

H. D. N. WALES, 1905. (See Table, p. 35.)

#### *Red soil, with red subsoil.*

This worn red lime soil responded freely only to applications of cotton seed meal. Other tests made in Madison County indicate a general need on such soils for both nitrogen and phosphate. Results from potash have been variable, the majority of the tests showing that little or no potash is needed.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	376
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	144
To acid phosphate plot .....	96
To kainit plot .....	144
<hr/>	
<i>Average increase with cotton seed meal</i> .....	128
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	88
To cotton seed meal plot .....	40
To kainit plot .....	32
<hr/>	
<i>Average increase with acid phosphate</i> .....	24
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	72
To cotton seed meal plot .....	72
To acid phosphate plot .....	48
<hr/>	
<i>Average increase with kainit</i> .....	24

*Experiments in Madison, Lawrence and Morgan Counties.*

Plot No.	Amount per acre	FERTILIZER  KIND	HUNTS- VILLE		HILLS- BORO		HART- SELLE Red land		HART- SELLE Gray land	
			Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal .....	520	144	272	48	798	112	780	210
2	240	Acid phosphate .....	464	88	264	40	776	120	1140	370
3	...	No fertilizer .....	376	...	224	...	656	...	570	...
4	200	Kainit .....	448	72	247	21	744	94	680	126
5	200	Cotton seed meal ...	560	184	496	265	744	100	1210	672
	240	Acid phosphate ...								
6	200	Cotton seed meal ...	592	216	424	190	712	74	980	350
	200	Kainit .....								
7	240	Acid phosphate .....	416	40	456	219	632	1	900	394
	200	Kainit .....								
8	...	No fertilizer .....	376	...	240	...	624	...	490	...
9	200	Cotton seed meal ...	...	...	744	504	864	240	1070	560
	240	Acid phosphate .....								
	200	Kainit .....								
10	200	Cotton seed meal ...	...	...	616	376	752	128	1010	520
	240	Acid phosphate .....								
	100	Kainit .....								

LAWRENCE COUNTY, 1 MILE EAST OF HILLSBORO.

F. T. NEALY, 1905. (See Table above.)

*Gray sandy loam soil, with yellow subsoil.*

This field had been cleared about 70 years of its growth of hardwoods. It had grown up in weeds during the four years preceding this experiment. Rains were almost continuous throughout the season, making cultivation almost impossible. Under these unfavorable conditions a complete fertilizer was the most effective and profitable.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	232
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	48
To acid phosphate plot .....	225
To kainit plot .....	161
To acid phosphate and kainit plot.....	285
<hr/>	
<i>Average increase with cotton seed meal</i> .....	180
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	40
To cotton seed meal plot .....	217
To kainit plot .....	198
To cotton seed meal and kainit plot .....	314
<hr/>	
<i>Average increase with acid phosphate</i> .....	192
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	21
To cotton seed meal plot .....	142
To acid phosphate plot .....	179
To cotton seed meal and acid phosphate plot .....	239
<hr/>	
<i>Average increase with kainit</i> .....	145

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MORGAN COUNTY, 4 MILES WEST OF HARTSELLE.

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J. O. BURLISON, 1907-8. (See Table, p. 35.)

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*In 1907, soil, red, lime table land; Subsoil, red. The original growth was hickory, removed about 80 years before.*

The soil was the ordinary lime soil of the Tennessee Valley Region. A complete fertilizer afforded the largest yield. Apparently the greatest need was for nitrogen.

*In 1908, typical sandy mountain land, dark gray soil with red subsoil.*

The original growth was shortleaf pine and hardwoods, and the land had been in cultivation about 10 years. The largest increase was afforded by a mixture of cotton seed meal and acid phosphate. The chemical chiefly needed by this soil was acid phosphate.

	Lbs.	Lbs.
<i>Average yield of seed cotton per arre, unfertilized.</i> .....	640	530
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	112	210
To acid phosphate plot .....	—20	402
To kainit plot .....	—20	—20
To acid phosphate and kainit plot .....	239	230
<hr/>		
<i>Average increase with cotton seed meal</i> .....	78	206
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	120	370
To cotton seed meal plot .....	—12	462
To kainit plot .....	—93	268
To cotton seed meal and kainit plot .....	166	230
<hr/>		
<i>Average increase with acid phosphate</i> .....	45	333
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	94	126
To cotton seed meal plot .....	—38	140
To acid phosphate plot .....	—119	24
To cotton seed meal and acid phosphate plot .....	140	—92
<hr/>		
<i>Average increase with kainit</i> .....	19	50

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CULLMAN COUNTY, 2 MILES SOUTH WEST OF JOPPA.

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O. G. ROBERTS, 1906-7-8. (See Table, p. 39.)

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*Gray sandy upland with yellow clay subsoil.*

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The original growth was short leaf pines and hardwoods, characteristic of the Mountain Plateau Region. This field had been cleared for about 24 years.

In all three years the largest profit was made on plot 5 by using a mixture of cotton seed meal and acid phosphate. In every case there was no advantage in adding kainit to the other two chemicals. This inefficiency of potash in these tests is further borne out by the fact that, of the two complete fertilizers, the one with the smaller amount of potash each year afforded the larger yield. These results also agree with the results of Mr. Burleson's tests on similar gray plateau soil.



	1906.	1907.	1908.
	Lbs.	Lbs.	Lbs.
<i>Average yield of seed cotton per acre unfertilized</i> ..	248	360	312
Increase in seed cotton when cotton seed meal was added:			
To unfertilized plot .....	200	22	144
To acid phosphate plot .....	174	218	132
To kainit plot .....	190	58	166
To acid phosphate and kainit plot .....	—17	43	164
<i>Average increase with cotton seed meal</i> .....	137	85	152
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot .....	288	174	292
To cotton seed meal plot .....	262	370	280
To kainit plot .....	342	121	112
To cotton seed meal and kainit plot .....	135	114	110
<i>Average increase with acid phosphate</i> .....	257	195	199
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot .....	75	182	156
To cotton seed meal plot .....	65	210	178
To acid phosphate plot .....	129	129	—24
To cotton seed meal and acid phosphate plot .....	—62	—46	8
<i>Average increase with kainit</i> .....	52	119	80

*Fertilizer Experiments in Blount, Cullman, Marion, Winston and Walker Counties.*

Plot No.	FERTILIZER	JOPPA 1906		JOPPA 1907		JOPPA 1908		TID-MORE 1905		CULLMAN 1906		HAMILTON 1906		NAUVOO 1908		CORDOVA 1908	
		Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	KIND																
	Amount per acre																
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200 Cotton seed meal...	416	200	438	22	472	144	[568]	[372]	544	152	288	32	490	90	1460	320
2	240 Acid phosphate...	504	288	590	174	620	292	276	80	588	196	310	64	595	195	1560	420
3	.... No fertilizer.....	216	....	416	....	328	....	196	....	392	....	256	....	400	....	1140	....
4	200 Kainit.....	304	75	576	182	476	156	264	70	553	136	312	49	480	81	1270	120
5	200 Cotton seed meal...	664	462	764	392	736	424	380	188	904	[464]	632	362	790	392	1500	340
6	240 Acid phosphate..	520	265	582	232	626	322	376	186	832	368	456	180	605	208	....	....
7	200 Kainit.....	648	417	630	303	564	268	220	33	800	312	544	262	550	154	1630	450
8	200 Kainit.....	280	....	304	....	288	....	184	....	512	....	288	....	395	....	1190	....
9	200 Cotton seed meal	680	400	650	3450	720	432	372	188	872	360	592	304	820	425	1560	370
10	240 Acid phosphate..	720	440	684	390	726	438	352	168	912	400	528	240	860	465	1800	610
	200 Kainit.....																
	200 Cotton seed meal																
	240 Acid phosphate..																
	100 Kainit.....																

BLOUNT COUNTY, 2 MILES NORTH OF TIDMORE.

JOHN W. STAAB, 1905. (See Table, p. 39.)

*Mulatto, fine sandy loam, with reddish yellow subsoil.*

The rainfall was heavy. Apparently plot 1 was on richer land than the other plots. The chief need was for nitrogen. Phosphate and kainit were of little value.

On the other hand, in a similar experiment made by Mr. Staab the preceding year on apparently the same character of land, the increase in yield of seed cotton per acre averaged for cotton seed meal 215 pounds, for acid phosphate 282 pounds, and for kainit 77 pounds.

	Lbs.
<i>Average yield of seed cotton, unfertilized</i> .....	190
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	
To acid phosphate plot .....	108
To kainit plot .....	116
To acid phosphate and kainit plot .....	155
<i>Average increase with cotton seed meal</i> .....	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	80
To cotton seed meal plot .....	
To kainit plot .....	37
To cotton seed meal and kainit plot .....	2
<i>Average increase with acid phosphate</i> .....	15
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	70
To cotton seed meal plot .....	
To acid phosphate plot .....	47
To cotton seed meal and acid phosphate plot .....	00
<i>Average increase with kainit</i> .....	8

## CULLMAN COUNTY, 1 MILE SOUTH OF CULLMAN.

L. A. FEALY, 1906. (See Table, p. 39.)

*Gray sandy loam, with yellow loam subsoil.*

On this upland field, long in cultivation, a mixture of acid phosphate and cotton seed meal gave the largest yield; but this result may have been due to the fact that this plot occupied the lowest position in the field. On this account it is impossible to determine whether potash was needed on this soil.

In 1904 on similar land Mr. Fealy made a test in which the average increase from cotton seed meal was 180 pounds, from acid phosphate 176 pounds, and from kainit 98 pounds.

	Lbs.
<i>Average yield of seed cotton, unfertilized</i> .....	452
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot .....	152
To acid phosphate plot .....	268
To kainit plot .....	232
To acid phosphate and kainit plot .....	48
<i>Average increase with cotton seed meal</i> .....	175
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	196
To cotton seed meal plot ..	312
To kainit plot .....	176
To cotton seed meal and kainit plot .....	8
<i>Average increase with acid phosphate</i> .....	169
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	136
To cotton seed meal plot .....	216
To acid phosphate plot .....	116
To cotton seed meal and acid phosphate plot .....	104
<i>Average increase with kainit</i> .....	98

## MARION COUNTY, HAMILTON.

SIXTH DISTRICT AGRICULTURAL SCHOOL, 1906. (Table, p. 39.)

*Sandy land with yellow clay subsoil.*

For 3 or 4 years preceeding the experiment this land had been uncultivated and occupied by weeds.

The largest and most profitable yield was afforded by plot 5, fertilized with cotton seed meal and acid phosphate. A test made on the same farm in 1903 (Ala. Station Bulletin No. 131) showed a need for a complete fertilizer, in which, however, potash was less effective than either nitrogen or phosphate.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	272
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	32
To acid phosphate plot .....	298
To kainit plot .....	131
To acid phosphate and kainit plot .....	42
<i>Average increase with cotton seed meal</i> .....	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	64
To cotton seed meal plot .....	330
To kainit plot .....	213
To cotton seed meal and kainit plot .....	124
<i>Average increase with acid phosphate</i> .....	183
Increase of seed cotton per acre when kainit was added:	
<i>Average yield of seed cotton per acre, unfertilized</i> .....	397
To unfertilized plot .....	49
To cotton seed meal plot .....	148
To acid phosphate plot .....	198
To cotton seed meal and acid phosphate plot .....	58
<i>Average increase with kainit</i> .....	84

## WINSTON COUNTY, 3 MILES NORTH EAST OF NAUVOO.

W. M. OMARY, 1908. (See Table, p. 39.)

*Gray sandy soil with a reddish clay subsoil; "coal land."*

This field had been in cultivation only about 6 years; the original growth is stated to have been short leaf pine.

While a complete fertilizer afforded the largest yield, yet the increase on plot 5, receiving only cotton seed meal and phosphate, was almost as large and the profit on plot 5 was even greater than on plot 9.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> . . . . .	397
Increase of seed cotton where cotton seed meal was added:	
To unfertilized plot . . . . .	90
To acid phosphate plot . . . . .	197
To kainit plot . . . . .	127
To acid phosphate and kainit plot . . . . .	271
<i>Average increase with cotton seed meal</i> . . . . .	171
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot . . . . .	195
To cotton seed meal plot . . . . .	302
To kainit plot . . . . .	73
To cotton seed meal and kainit plot . . . . .	217
<i>Average increase with acid phosphate</i> . . . . .	197
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot . . . . .	81
To cotton seed meal plot . . . . .	118
To acid phosphate plot . . . . .	41
To cotton seed meal and acid phosphate plot . . . . .	33
<i>Average increase with kainit</i> . . . . .	48

## WALKER COUNTY, 3 MILES SOUTH OF CORDOVA.

G. L. ALEXANDER, 1908. (See Table, p. 39.)

*Gray sandy upland with red clay subsoil.*

This field had been cleared for about 40 years. Evidently the land had been kept in a high state of fertility.

The stand was uniform.

It is clear that the chief need of this soil was for acid phosphate. There was no need for potash. The figures for nitrogen are confusing, probably due to the relatively productive condition of this land. Apparently plot 10 was on richer soil than the other plots.

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*Average yield of seed cotton per acre, unfertilized* 1165

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot ..... 320

To acid phosphate plot ..... 80

To acid phosphate and kainit plot ..... 80

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*Average increase with cotton seed meal* ..... 54

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot ..... 420

To cotton seed meal plot ..... 20

To kainit plot ..... 330

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*Average increase with acid phosphate* ..... 257

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ..... 120

To acid phosphate plot ..... 30

To cotton seed meal and acid phosphate plot ..... 30

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*Average increase with kainit* ..... 60

## FAYETTE COUNTY, 1 1-2 MILES WEST OF NEWTONVILLE.

J. B. GIBSON, 1906-7. (See Table, p. 46.)

*Dark sandy soil with red clay subsoil.*

This level upland field, on which the original growth was oak and short leaf pine, has been cleared about 18 years.

There was an increase with either cotton seed meal, acid phosphate, or kainit, whether these were used separately or in every possible combination. Apparently the greatest need was for acid phosphate.

	1906.	1907.
	Lbs.	Lbs.
<i>Average yield of seed cotton, unfertilized</i> .....	560	348
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	784	576
To acid phosphate plot .....	24	86
To kainit plot .....	72	54
To acid phosphate and kainit plot .....	216	92
<i>Average increase with cotton seed meal</i> .....	274	202
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	880	640
To cotton seed meal plot .....	120	150
To kainit plot .....	128	129
To cotton seed meal and kainit plot .....	268	167
<i>Average increase with acid phosphate</i> .....	349	272
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	720	611
To cotton seed meal plot .....	8	89
To acid phosphate plot .....	—32	100
To cotton seed meal and acid phosphate plot .....	160	106
<i>Average increase with kainit</i> .....	214	227



*Fertilizer Experiments in Fayette and Greene Counties.*

Plot No	FERTILIZER		NEWTON-VILLE 1906		NEWTON-VILLE 1907		CLINTON 1908	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal .....	1304	784	912	576	768	144
2	240	Acid phosphate .....	1400	880	976	640	760	136
3	.....	No fertilizer.....	520	.....	336	.....	624	.....
4	200	Kainit .....	1256	720	952	611	672	49
5	200	Cotton seed meal ....	1456	904	1072	726	696	74
	240	Acid phosphate ....						
6	200	Cotton seed meal ....	1360	792	1016	665	687	08
	207	Kainit .....						
7	240	Acid phosphate ....	1432	848	1096	740	622	14
	200	Kainit .....						
8	.....	No fertilizer.....	600	.....	360	.....	616	.....
9	200	Cotton seed meal ....	1664	1064	1192	832	680	64
	240	Acid phosphate ....						
	200	Kainit .....	1600	1000	1272	912	704	88
10	200	Cotton seed meal ....						
	240	Acid phosphate ....						
	100	Kainit .....						

GREENE COUNTY, 6 MILES NORTH OF CLINTON.

W. M. MORGAN, 1908. (See Table above.)

*Dark soil with clay foundation.*

The original growth, consisting chiefly of short leaf pine, was removed about nine years before the test was made. The two crops preceding the experiment consisted of cotton. No fertilizer very greatly increased the yield. From Mr. Morgan's notes it may be inferred that the land is in poor mechanical condition, much inclined to bake, and that on all plots there was much shedding of forms, but no rust.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	620
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	144
To acid phosphate plot .....	—62
To kainit plot .....	19
To acid phosphate and kainit plot .....	50
<hr/>	
<i>Average increase with cotton seed meal</i> .....	38

Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	136
To cotton seed meal plot .....	—70
To kainit plot .....	—35
To cotton seed meal and kainit plot .....	4
<hr/>	
<i>Average increase with acid phosphate</i> .....	7

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	49
To cotton seed meal plot .....	—76
To acid phosphate plot .....	—122
To cotton seed meal and acid phosphate plot .....	10
<hr/>	
<i>Average increase with kainit</i> .....	40

#### CHILTON COUNTY, 2 MILES WEST OF VERBENA.

J. H. WILLOUGHBY, 1905-6-7-8. (See Table, p. 49.)

#### *Gray sandy soil with a red subsoil.*

Every year this test was made on soil that had been long in cultivation. In each of the four years the complete fertilizer (plot 9) afforded a larger yield than the mixture of any two fertilizers. In every test the complete fertilizer afforded the largest net profit. When the chemicals were used separately or by twos their effect was variable, but when all 3 were combined each chemical in this mixture increased the yield more than enough to pay its cost.

	1905	1906	1907	1908
	Lbs.	Lbs.	Lbs.	Lbs.
<i>Average yield of seed cotton per acre unfertilized</i> .....	408	256	328	550
Increase of seed cotton when cotton seed meal was added:				
To unfertilized plot .....	384	104	64	230
To acid phosphate plot .....	104	85	60	142
To kainit plot .....	96	21	—36	—18
To acid phosphate and kainit plot .....	272	62	279	256
<i>Average increase with cotton seed meal</i> .....	214	68	60	153

Increase of seed cotton per acre when acid phosphate was added:				
To unfertilized plot .....	168	128	32	50
To cotton seed meal plot .....	—112	109	156	—38
To kainit plot .....	16	36	—101	—142
To cotton seed meal and kainit plot .....	192	77	214	132
<i>Average increase with acid phosphate</i> .....	66	87	75	1

Increase of seed cotton per acre when kainit was added:				
To unfertilized plot .....	136	206	158	186
To cotton seed meal plot .....	—152	123	186	—62
To acid phosphate plot .....	—16	114	25	—6
To cotton seed meal and acid phosphate plot ..	152	91	244	108
<i>Average increase with kainit</i> .....	30	133	153	57

*Verbena (Chilton County) Experiments by J. H. Willoughby and G. H. Caffey.*

Plot No.	FERTILIZER	KIND	VERBENA W. 1905			VERBENA W. 1906			VERBENA W. 1907			VERBENA C. 1907			VERBENA C. 1908		
			Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	
			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	
1	200	Cotton seed meal	752	384	376	104	640	64	820	230	888	144	710	160	710	80	
2	240	Acid phosphate	536	168	410	128	736	32	640	50	653	91	710	80	710	80	
3	....	No fertilizer	368	....	272	....	704	....	590	....	744	....	630	....	630	....	
4	200	Kainit	520	136	472	206	832	158	760	186	904	196	650	40	650	40	
5	200	Cotton seed meal	672	272	472	213	736	92	750	192	848	177	910	320	910	320	
6	240	Acid phosphate	648	232	380	227	736	122	710	168	848	214	740	170	740	170	
7	200	Kainit	584	152	488	242	640	57	570	44	900	103	680	130	680	130	
8	....	No fertilizer	448	....	240	....	552	....	510	....	560	....	530	....	530	....	
9	200	Cotton seed meal	872	424	544	304	888	336	810	300	1024	464	860	303	860	303	
10	240	Acid phosphate	760	312	456	216	856	304	800	290	952	392	810	280	810	280	
	100	Kainit	....	....	....	....	....	....	....	....	....	....	....	....	....	....	

CHILTON COUNTY, 1-2 MILE SOUTH OF VERBENA.  
G. H. CAFFEY, 1907-8. (See Table, p. 49.)

*Rather stiff, dark, sandy soil, with a red clay subsoil.*

This piece of high upland was cleared 60 or 70 years ago of its original growth of longleaf pine, oak, hickory, and dogwood. The results for the two years suggest that the fertilizer which pays best one season is not necessarily the one most effective in a different season. In 1907 there was need for a complete fertilizer, in which the most effective constituent was nitrogen, closely followed by potash; phosphate was also helpful when used in combination, with *both* of the other constituents.

In 1908, on the contrary, kainit was of practically no value nitrogen being most important, followed by phosphate. A mixture of cotton seed meal and phosphate gave the greatest profit.

In 1907 the complete fertilizer on plot 9, costing \$5.68 per acre, increased the yield of seed cotton by 464 pounds per acre, worth at 3.2 cents, \$14.85. This leaves a net profit of \$8.17 due to the complete fertilizer. Likewise in 1908 the increase on plot 5, with meal and phosphate costing \$4.28, afforded a net profit of \$5.96.

	1907	1908
	Lbs. Lbs.	
Average yield of seed cotton unfertilized .....	652	580
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	144	160
To acid phosphate plot .....	268	240
To kainit plot .....	18	130
To acid phosphate and kainit plot .....	361	200
Average increase with cotton seed meal .....	198	183

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	—91	80
To cotton seed meal plot .....	33	160
To kainit plot .....	—93	90
To cotton seed meal and kainit plot .....	250	160

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*Average increase with acid phosphate* ..... 25    123

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	196	40
To cotton seed meal plot .....	70	10
To acid phosphate plot .....	194	50
To cotton seed meal and acid phosphate plot.....	287	10

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*Average increase with kainit* .....187    28

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AUTAUGA COUNTY, 2 MILES EAST OF PRATTVILLE.

J. W. YOUNG, 1905-6-7. (See Table, p. 52.)

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*Reddish sandy soil with a red clay subsoil.*

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The stand each year was good and uniform. Results were somewhat obscured by unfavorable weather conditions in 1905 and by the September storm and the occurrence of early frost in 1906. Evidently the chief need of the soil, long in cultivation, was for nitrogen. Phosphoric acid was also needed. A mixture of cotton seed meal and acid phosphate, (plot 5), in all cases gave a profitable increase. In a complete fertilizer in 1905 and 1906 kainit increased the yield to the extent of 112 and 77 pounds of seed cotton respectively; but when used alone or in combination with either one of the other fertilizers, kainit was usually unprofitable, and it was also without effect in the complete fertilizer in 1907.

*Autauga and Montgomery (Sandy Land) Experiments.*

Plot No.	Amount per acre	FERTILIZER  KIND	Pratt-ville 1904		Pratt-ville 1905		Pratt-ville 1906		MONT- GOMERY Red sandy	
			Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal ...	816	184	936	296	912	156	744	112
2	240	Acid phosphate ...	752	120	800	160	816	60	664	32
3	...	No fertilizer .....	632	...	640	...	756	...	632	...
4	200	Kainit .....	640	24	680	34	780	12	552	66
5	200	Cotton seed meal ...	760	160	840	187	888	109	720	116
6	240	Acid phosphate ...	752	168	760	101	892	102	752	1620
7	200	Cotton seed meal ...	744	176	696	30	708	93	643	73
8	200	Kainit .....	552	...	672	...	812	...	560	...
9	200	Cotton seed meal ...	824	272	936	264	880	68	824	264
10	240	Acid phosphate ...	768	216	856	184	800	12	840	280
	100	Kainit .....								

	1905	1906	1907
	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
<i>Average yield of seed cotton, unfertilized</i> .....	592	656	784
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot : .....	184	296	156
To acid phosphate plot .....	40	27	49
To kainit plot .....	144	67	90
To acid phosphate and kainit plot .....	96	234	151
<i>Average increase with cotton seed meal</i> .....	116	156	112

Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot .....	120	160	60
To cotton seed meal plot .....	24	109	47
To kainit plot .....	152	4	105
To cotton seed meal and kainit plot .....	104	163	34
<i>Average increase with acid phosphate</i> .....	88	53	32

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	24	34	12
To cotton seed meal plot .....	—16	—195	—54
To acid phosphate plot .....	56	—130	—153
To cotton seed meal and acid phosphate plot .....	112	77	—41
<i>Average increase with kainit .....</i>	<i>44</i>	<i>—53</i>	<i>—59</i>

MARENGO COUNTY, 2 MILES SOUTH OF FAUNSDALE.

W. C. MCKNIGHT, 1905. (See Table, p. 54.)

*Yellowish, gravelly, prairie upland.*

The largest increase and the only plot showing any decided profit from fertilizers was plot 10, which received 550 pounds of a complete fertilizer.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized .....</i>	<i>414</i>
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	62
To acid phosphate plot .....	170
To kainit plot .....	48
To acid phosphate and kainit plot .....	210
<i>Average increase with cotton seed meal .....</i>	<i>122</i>

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	—82
To cotton seed meal plot .....	56
To kainit plot .....	—42
To cotton seed meal and kainit plot .....	120
<i>Average increase with acid phosphate .....</i>	<i>13</i>

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	—20
To cotton seed meal plot .....	56
To acid phosphate plot .....	20
To cotton seed meal and acid phosphate plot .....	30
<i>Average increase with kainit .....</i>	<i>21</i>



**Fertilizer Experiments in Marengo and Montgomery Counties  
on prairie or lime soils.**

Plot No.	FERTILIZER		FAUNSDALE		MONTGOMERY Prairie		MONTGOMERY Prairie		MONTGOMERY Prairie	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal.....	516	62	492	120	256	78	643	143
2	240	Acid phosphate.....	372	82	648	276	320	14	483	15
3	....	No fertilizer .....	454	....	372	....	334	....	498	....
4	200	Kainit .....	418	20	558	183	580	233	590	119
5	200	Cotton seed meal... }	540	118	528	149	402	42	578	134
	240	Acid phosphate.... }								
6	200	Cotton seed meal .. }	434	28	528	146	694	322	663	246
	200	Kainit .....								
7	240	Acid phosphate.... }	328	62	648	268	690	306	593	203
	200	Kainit.....								
8	....	No fertilizer .....	374	....	388	....	396	....	363	....
9	200	Cotton seed meal... }	522	148	694	310	672	276	853	490
	240	Acid phosphate.... }								
	200	Kainit .....								
	200	Cotton seed meal .. }								
10	240	Acid phosphate.... }	638	264	726	338	618	220	723	360
	100	Kainit.....								

MONTGOMERY COUNTY, 6 MILES SOUTH EAST OF MONTGOMERY.

WESLEY N. JONES AND SONS, 1906-7-8.

*Black prairie soil in 1906; reddish prairie soil in 1907;  
chocolate or "mulatto" prairie soil in 1908.*

In 1906 on black or dark gray prairie upland soil, the greatest increase, 338 pounds of seed cotton per acre, and the largest profit, was afforded by the complete fertilizer applied to plot 10. Apparently the chief need that year was for acid phosphate, though kainit was also helpful.

In 1907 the greatest increase was afforded by a mixture of cotton seed meal and kainit, closely followed by the plot receiving acid phosphate and kainit. In this test kainit was the only profitable fertilizer and was effective whether used alone or in combination with either acid phosphate or

kainit. The poor results on plots 1 and 2 and 5 appear to be partly due to the slightly poorer stand on those plots.

In 1908 a complete fertilizer was the most profitable; in this potash was most important, nitrogen next. Acid phosphate was ineffective when used alone or with meal, but profitable when combined with both kainit and meal, making a complete fertilizer.

In the 3 tests on this typical prairie soil, the most profitable fertilizer was in two cases a complete fertilizer and in one case kainit.

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	1906	1907	1908
	Lbs	Lbs	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i>	380	365	431
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot .....	120	78	145
To acid phosphate plot .....	127	66	149
To kainit plot .....	37	89	127
To acid phosphate and kainit plot .....	42	30	187
<i>Average increase with cotton seed meal</i> .....	1	12	152

Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot .....	276	14	15
To cotton seed meal plot .....	29	120	11
To kainit plot .....	85	73	84
To cotton seed meal and kainit plot .....	164	46	144
<i>Average increase with acid phosphate</i> .....	130	33	50

Increase of seed cotton per acre when kainit was added:			
To unfertilized plot .....	183	233	119
To cotton seed meal plot .....	26	400	101
To acid phosphate plot .....	8	320	218
To cotton seed meal and acid phosphate plot .....	161	234	356
<i>Average increase with kainit</i> .....	91	297	199

## MONTGOMERY COUNTY, 7 MILES EAST OF MONTGOMERY.

THOS. W. OLIVER, 1907. (See Table, p. 52.)

*Red sandy soil 4 to 6 in deep; red clay subsoil.*

The field had been cleared perhaps 70 years before. The original growth was reported as short leaf pine and oak.

The season was unfavorable, the spring being very wet and the late summer very dry and hot.

A complete fertilizer, especially the one on plot 10, was the most profitable.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	596
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	112
To acid phosphate plot .....	84
To kainit plot .....	228
To acid phosphate and kainit plot .....	191
<i>Average increase with cotton seed meal</i> .....	154
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	32
To cotton seed meal plot .....	4
To kainit plot .....	139
To cotton seed meal and kainit plot .....	102
<i>Average increase with acid phosphate</i> .....	69
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	86
To cotton seed meal plot .....	50
To acid phosphate plot .....	41
To cotton seed meal and acid phosphate plot .....	148
<i>Average increase with kainit</i> .....	43

LEE COUNTY, EXPERIMENT STATION FARM.

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Results of fertilizer experiments in 1905 and 1906 are reserved for another publication. Expressed briefly the results showed that on gray sandy soil (Norfolk sandy loam), the greatest increase was from potash, next from nitrogen, and the least from phosphate. The latter fact may be due to an accumulation of phosphoric acid brought about by fertilization with acid phosphate each year.

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LEE COUNTY, 2 MILES WEST OF AUBURN.

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JOHN JACKSON, 1908. (See Table, p. 58.)

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*Gray sandy loam, long in cultivation.*

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The largest increase, 500 pounds per acre, was afforded by plot 9, on which was used 640 pounds per acre of a complete fertilizer. This represents, at 3.2 cents per pound of seed cotton, a net profit of \$10.32 per acre above the cost of fertilizer. It should be added that the increased crop as measured by the scales was very much greater than the appearance of the plants would suggest to the eye.

Every one of the three constituents of the complete fertilizer was profitable in this mixture.

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*Average yield of seed cotton, unfertilized*.....560

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot .....190

To acid phosphate plot ..... 10

To kainit plot .....—140

To acid phosphate and kainit plot .....320

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*Average increase with cotton seed meal*..... 95

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....100

To cotton seed meal plot .....—80

To kainit plot .....—118

To cotton seed meal and kainit plot .....350

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*Average increase with acid phosphate* ..... 63

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	290
To cotton seed meal plot .....	40
To acid phosphate plot .....	80
To cotton seed meal and acid phosphate plot .....	390
<hr/>	
Average increase with kainit .....	180

### Fertilizer Experiments in Lee County.

Plot No.	FERTILIZER		AUBURN J. Jackson		BEEHIVE		BEEHIVE	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal .....	800	190	428	156	280	96
2	240	Acid phosphate .....	710	100	424	152	304	120
3	....	No fertilizer .....	610	....	272	....	184	....
4	200	Kainit .....	980	290	484	202	304	123
5	200	Cotton seed meal .....	680	110	552	260	560	382
	240	Acid phosphate .....						
6	200	Cotton seed meal .....	700	150	692	392	400	525
	200	Kainit .....						
7	240	Acid phosphate .....	710	180	608	297	444	273
	200	Kainit .....						
8	....	No fertilizer .....	510	....	320	....	168	....
9	200	Cotton seed meal .....	1010	500	624	304	640	472
	240	Acid phosphate .....						
	200	Kainit .....						
10	200	Cotton seed meal .....	750	240	560	240	560	392
	240	Acid phosphate .....						
	100	Kainit .....						

LEE COUNTY, 4 MILES SOUTH OF LOACHAPOKA, AT BEEHIVE.

T. W. Cox, 1905-6.

*Coarse sandy soil with yellow sandy subsoil.*

This piece of upland had been in cultivation for many years. In 1905 rust was severe on all plots. The stand of plants was uniform. On this very poor coarse sandy soil

plot 6, fertilized with meal and kainit, gave the largest yield and the most profit in 1905, in which year every fertilizer was useful when applied alone or by twos.

In 1906 plot 9, receiving 640 pounds of complete fertilizer, afforded the largest yield and the greatest net profit. The latter test agrees with Mr. Jackson's in showing the need of a complete fertilizer on the coarse gray sandy soils of this region.

	1905	1906
	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	296	176
To unfertilized plot .....	156	96
To acid phosphate plot .....	108	260
To kainit plot .....	190	2
To acid phosphate and kainit plot .....	7	201
<i>Average increase with cotton seed meal</i> .....	115	140
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	152	120
To cotton seed meal plot .....	104	287
To kainit plot .....	95	150
To cotton seed meal and kainit plot .....	—88	247
<i>Average increase with acid phosphate</i> .....	66	201
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	202	123
To cotton seed meal plot .....	236	129
To acid phosphate plot .....	145	153
To cotton seed meal and acid phosphate plot .....	44	90
<i>Average increase with kainit</i> .....	157	124

TALLAPOOSA COUNTY, 8 MILES WEST OF NOTASULGA.

M. E. PARKER, 1905-6. (See Table, p. 61.)

*Gray sandy upland; yellowish subsoil.*

This field was on representative long-leaf pine land, and had been in cultivation about 20 years. The five crops pre-

ceding that of 1905 were cotton fertilized with 200 pounds of guano per acre.

In 1905 cotton rust was severe and a complete fertilizer was most profitable, (plot 9 and 10); this year every fertilizer, whether applied alone, by twos, or all three together greatly increased the yield.

In 1906 the test was conducted on land that had been in oats the year before. This was a rainy season on this farm. Plot 10, with a complete fertilizer gave the largest increase and greatest profit, while plot 9, receiving a complete fertilizer with double this amount of potash, dropped lower in yield. There is no question of the effectiveness of phosphate and meal. But the results with kainit are here contradictory, this fertilizer making a satisfactory increase when used alone and also when used in the complete fertilizer on plot 10; but in other combinations kainit failed to increase the yield to any notable extent.

	1905	1906
	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	500	621
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	320	127
To acid phosphate plot .....	128	104
To kainit plot .....	40	—26
To acid phosphate and kainit plot .....	160	88
<i>Average increase with cotton seed meal</i> .....	162	73
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	264	187
To cotton seed meal plot .....	72	166
To kainit plot .....	16	—35
To cotton seed meal and kainit plot .....	136	79
<i>Average increase with acid phosphate</i> .....	122	100
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	336	224
To cotton seed meal plot .....	56	71
To acid phosphate plot .....	88	0
To cotton seed meal and acid phosphate plot .....	120	—16
<i>Average increase with kainit</i> .....	150	70

*Fertilizer Experiments in Tallapoosa and Macon Counties.*

PLOT No.	FERTILIZER	W. N. O. T. A. 'G. A. W.			M. E. Parker			W. N. O. T. A. 'G. A. W.			J. W. Parker			E. B. Jackson			W. N. O. T. A. 'G. A. W.			S. C. Jackson			SHORTER Swearing-ton	
		1905			1906			1907			1907			1908			1905			1906				
Amount per acre	KIND	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	Yield of seed	Increase over	
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		
1	Cotton seed meal...	840	320	748	127	520	104	272	80	680	280	368	72	256	40	256	40	256	40	256	40	256	40	
2	Acid phosphate...	784	264	810	189	480	64	256	64	500	100	384	88	264	48	264	48	264	48	264	48	264	48	
3	No fertilizer...	520	...	621	...	416	...	192	...	400	...	296	...	216	...	216	...	216	...	216	...	216	...	
4	Kainit...	848	336	845	224	512	123	216	25	530	112	368	75	544	325	544	325	544	325	544	325	544	325	
5	Cotton seed meal...	896	392	914	293	632	270	296	106	500	84	552	262	464	244	464	244	464	244	464	244	464	244	
6	Acid phosphate...	872	376	819	198	584	249	312	124	650	236	520	233	768	546	768	546	768	546	768	546	768	546	
7	Cotton seed meal...	840	352	810	189	568	260	304	118	550	138	344	60	640	416	640	416	640	416	640	416	640	416	
8	Kainit...	480	...	...	...	280	...	184	...	410	...	280	...	224	...	224	...	224	...	224	...	224	...	
9	No fertilizer...	992	512	898	277	656	376	400	216	680	270	536	256	768	544	768	544	768	544	768	544	768	544	
10	Cotton seed meal...	1000	520	1026	405	576	296	416	232	720	310	536	256	768	544	768	544	768	544	768	544	768	544	
	Acid phosphate...	1000	520	1026	405	576	296	416	232	720	310	536	256	768	544	768	544	768	544	768	544	768	544	
	Kainit...	1000	520	1026	405	576	296	416	232	720	310	536	256	768	544	768	544	768	544	768	544	768	544	



TALLAPOOSA COUNTY, 8 1-2 MILES WEST OF NOTASULGA.  
J. W. PARKER, 1907. (See Table, p. 61.)

*Gray sandy land; yellowish subsoil.*

This typical piece of long-leaf pine upland had been cultivated for many years.

The complete fertilizer on plot 10 was the most profitable, affording a net profit of \$6.35 per acre, (376 lbs. at 3.2 cents. less \$5.68).

June and July were very dry. Rust and shedding were severe on plots 5, 9 and 10; plots 4 and 7 retained their foliage remarkably well.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	348
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	104
To acid phosphate plot .....	206
To kainit plot .....	126
To acid phosphate and kainit plot.....	116
<i>Average increase with cotton seed meal</i> .....	138
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	64
To cotton seed meal plot .....	166
To kainit plot .....	137
To cotton seed meal and kainit plot.....	127
<i>Average increase with acid phosphate</i> .....	124
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	123
To cotton seed meal plot .....	145
To acid phosphate plot .....	196
To cotton seed meal and acid phosphate plot.....	106
<i>Average increase with kainit</i> .....	143

## TALLAPOOSA COUNTY, 6 MILES WEST OF NOTASULGA.

E. B. JACKSON, 1907-8. (See Table, p. 61.)

*Gray sandy upland; yellowish subsoil.*

This experiment was made on typical long-leaf pine land, which had been in cultivation for many years. The stands of cotton were good and uniform. There are no records to the presence or absence of cotton rust.

In both years a complete fertilizer was most effective and most profitable. However in a complete fertilizer, 100 pounds of kainit per acre (plot 10) was more advantageous than double this amount, (plot 9.)

	1907	1908
	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	188	405
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot .....	80	280
To acid phosphate plot .....	42	—16
To kainit plot .....	99	124
To acid phosphate and kainit plot .....	98	132
<i>Average increase with cotton seed meal</i> .....	80	130
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot .....	64	100
To cotton seed meal plot .....	26	—196
To kainit plot .....	93	26
To cotton seed meal and kainit plot .....	92	34
<i>Average increase with acid phosphate</i> .....	69	—9
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot .....	25	112
To cotton seed meal plot .....	44	—44
To acid phosphate plot .....	54	38
To cotton seed meal and acid phosphate plot .....	110	186
<i>Average increase with kainit</i> .....	58	73

MACON COUNTY, 6 MILES WEST OF NOTASULGA.  
S. C. JACKSON, 1905. (See Table, p. 61.)

*Gray sandy pine woods soil with yellowish subsoil.*

The original growth was long-leaf pine. The field had been in cultivation for many years. A mixture of acid phosphate and cotton seed meal (plot 5) was sufficient to give the largest yield and greatest profits.

Mr. Jackson noted that on plots receiving the complete fertilizer there were some spots where the plants died, probably from cotton wilt. This may explain why the complete fertilizer did not give a better yield.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	288
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	72
To acid phosphate plot .....	174
To kainit plot .....	158
To acid phosphate and kainit plot .....	204
<i>Average increase with cotton seed meal</i> .....	152
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	88
To cotton seed meal plot .....	190
To kainit plot .....	15
To cotton seed meal and kainit plot .....	31
<i>Average increase with acid phosphate</i> .....	73
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	75
To cotton seed meal plot .....	161
To acid phosphate plot .....	28
To cotton seed meal and acid phosphate plot .....	2
<i>Average increase with kainit</i> .....	52

MACON COUNTY, 9 MILES WEST OF TUSKEGEE.  
YANCEY SWEARINGTON, 1906. (See Table, p. 61.)

*Gray sandy soil with yellow loam subsoil.*

This field was cleared of its growth of long leaf pine about 60 years ago. The stand was good on all plots. It is notable that the complete fertilizer on plot 6 nearly quadrupled the yield on the unfertilized plots. This complete fertilizer afforded the largest yield and the greatest profit, but was closely followed in yield and profit by plot 6, receiving a mixture of cotton seed meal and kainit. In this test kainit was the most useful single fertilizer, a fact which was probably due to its effect in restraining rust, as indicated by Mr. Swearington's careful observations. By July 10 plot 5 was ruined by rust. Plots 4 and 6 suffered least from rust and were the last to show it. The rust was considered worse on plots 9 and 10 than on plot 5. Apparently rust was worse and earlier on plots receiving phosphate.

Mr. Swearington draws the following conclusion from this test:

"Our lands need more liberal use of potash."

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	220
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot .....	40
To acid phosphate plot .....	196
To kainit plot .....	221
To acid phosphate and kainit plot .....	184
<i>Average increase with cotton seed meal</i> .....	160
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	48
To cotton seed meal plot .....	204
To kainit plot .....	91
To cotton seed meal and kainit plot .....	54
<i>Average increase with acid phosphate</i> .....	99

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	325
To cotton seed meal plot .....	506
To acid phosphate plot .....	363
To cotton seed meal and acid phosphate plot .....	356
<b>Average increase with kainit .....</b>	<b>389</b>

*Fertilizer Experiments near Society Hill, Macon County.*

Plot No.	FERTILIZER		R. S. FLOYD 1906		R. S. FLOYD 1907		A. B. FLOYD 1908	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal ...	512	160	472	168	420	30
2	240	Acid phosphate ....	464	112	832	192	580	30
3	...	No fertilizer .....	352	...	640	...	450	...
4	200	Kainit .....	432	90	720	49	750	296
5	200	Cotton seed meal ...	552	220	1112	410	520	62
	240	Acid phosphate ..						
6	200	Cotton seed meal ...	448	125	728	-4	610	148
	200	Kainit .....						
7	240	Acid phosphate ..	424	111	856	94	550	84
	200	Kainit .....						
8	...	No fertilizer .....	304	...	792	...	470	...
	200	Cotton seed meal ...						
9	240	Acid phosphate ..	616	312	1168	376	990	520
	200	Kainit .....						
10	200	Cotton seed meal ...	554	280	1224	432	900	430
	240	Acid phosphate ..						
	100	Kainit .....						

MACON COUNTY, 5 MILES SOUTH WEST OF SOCIETY HILL.

R. S. AND A. B. FLOYD, 1906-7-8.

*Soil in 1907 dark sandy loam; in 1906 and 1908 gray sandy soil; yellow subsoil in all experiments.*

All these tests were made on land that had been long in cultivation. The original growth is reported as probably short-leaf pine and hardwood.

On gray sandy soil in 1906 and again in 1908 the com-

plete fertilizer was by far the most effective and most profitable application. In both of these years rust was prevalent but least severe on the plots receiving kainia. On the other hand, in 1907, a year in which no rust troubled any plot, a mixture of cotton seed meal and phosphate on plot 5 gave the greatest increase, kainit being practically without effect.

In both years when rust prevailed, plot 10, receiving 200 pounds of kainit in its complete fertilizer, yielded more than plot 10, where only half as much kainit was used in the complete fertilizer.

---

	1906	1907	1908
	Lbs.	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i>	328	716	460
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot .....	160	—168	—30
To acid phosphate plot .....	108	218	32
To kainit plot .....	35	—53	—148
To acid phosphate and kainit plot .....	201	282	436
<i>Average increase with cotton seed meal .....</i>	126	70	73

Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot .....	112	192	30
To cotton seed meal plot .....	60	578	92
To kainit plot .....	21	45	—212
To cotton seed meal and kainit plot .....	187	380	372
<i>Average increase with acid phosphate .....</i>	95	299	71

Increase of seed cotton per acre when kainit was added:			
To unfertilized plot .....	90	49	296
To cotton seed meal plot .....	—35	164	178
To acid phosphate plot .....	—1	—98	54
To cotton seed meal and acid phosphate plot .....	92	—34	458
<i>Average increase with kainit .....</i>	37	20	247

BULLOCK COUNTY, 9 MILES EAST OF UNION SPRINGS.  
A. M. COPE, 1906. (See Table, p. 69.)

*Gray sandy soil with porous yellow sandy subsoil.*

The original growth of short-leaf pine had been cleared many years before. The stand of cotton was very uniform. There was need of a complete fertilizer. Of the two complete fertilizers the one containing the larger amount of kainit per acre was more profitable. The need for nitrogen and for phosphate was somewhat greater than for potash.

The increase from the complete fertilizer on plot 9 was 760 pounds per acre, thus affording a net profit of \$18.61 above the cost of fertilizer and above the cost of picking the increase. Indeed every fertilizer, whether used singly or in any combination whatsoever, gave a profitable increase.

---

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	240
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot .....	256
To acid phosphate plot .....	232
To kainit plot .....	240
To acid phosphate and kainit plot .....	400
<i>Average increase with cotton seed meal</i> .....	282

Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	288
To cotton seed meal plot .....	264
To kainit plot .....	168
To cotton seed meal and kainit plot .....	328
<i>Average increase with acid phosphate</i> .....	262

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	192
To cotton seed meal plot .....	176
To acid phosphate plot .....	72
To cotton seed meal and acid phosphate plot .....	240
<i>Average increase with kainit</i> .....	170

*Fertilizer Experiments in Bullock, Barbour and Geneva Counties.*

Plot No.	FERTILIZER		Union Spgs A. M. COPE		LOUISVILLE		GENEVA	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal ...	496	256	304	104	736	268
2	240	Acid phosphate ...	528	288	272	72	640	192
3	...	No fertilizer .....	240	.....	200	.....	448	.....
4	200	Kainit .....	432	192	232	24	720	265
5	200	Cotton seed meal }	760	520	456	240	872	410
	240	Acid phosphate }						
6	200	Cotton seed meal }	672	432	472	248	720	252
	200	Kainit .....						
7	240	Acid phosphate }	600	360	312	80	624	150
	200	Kainit .....						
8	...	No fertilizer ...	240	.....	240	.....	480	.....
9	200	Cotton seed meal }	1000	760	456	216	920	440
	240	Acid phosphate }						
	200	Kainit .....						
10	200	Cotton seed meal }	808	568	480	240	872	392
	240	Acid phosphate }						
	100	Kainit .....						

BARBOUR COUNTY, 3 MILES NORTH OF LOUISVILLE.

By J. D. VEAL, 1905.

*Gray, sandy soil, with stiffer gray subsoil.*

This field had been long in cultivation.

The season was wet; rust was severe and all yields were small. Nitrogen afforded a larger increase than did phosphate or potash. The most profitable mixtures contained cotton seed meal, mixed either with acid phosphate or with kainit.

The year before, on the same or similar land, a complete fertilizer was the most profitable. Both years cotton seed meal and acid phosphate were needed.

In 1904 kainit was profitably used, giving an average increase of 100 pounds per acre, as compared with an average increase of only 38 pounds in 1905.



	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	220
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot .....	104
To acid phosphate plot .....	168
To kainit plot .....	224
To acid phosphate and kainit p'ot .....	136
<i>Average increase with cotton seed meal</i> .....	158
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	72
To cotton seed meal plot .....	136
To kainit plot .....	56
To cotton seed meal and kainit plot .....	32
<i>Average increase with acid phosphate</i> .....	58
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	24
To cotton seed meal plot .....	144
To acid phosphate plot .....	8
To cotton seed meal and acid phosphate plot .....	24
<i>Average increase with kainit</i> .....	38

GENEVA COUNTY, 4 1-2 MILES NORTH OF GENEVA  
M. P. METCALF, 1905.

*Gray sandy pine land with stiffer red subsoil eight inches  
from surface.*

The land had been in cultivation six years. Both cotton seed meal and acid phosphate were very effective, and a mixture of the two was the most profitable fertilizer. This year kainit was in most combinations useless.

In experiments on cotton made by Mr. Metcalf on similar land in preceding years the results indicated a need for phosphate; and in two of his experiments kainit was also very effective. Nitrogen was also needed except when supplied by a preceding crop of peanuts.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	464
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot .....	288
To acid phosphate plot .....	218
To kainit plot .....	13
To acid phosphate and kainit plot .....	290
<hr/>	
<i>Average increase with cotton seed meal</i> .....	196
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	192
To cotton seed meal plot .....	122
To kainit plot .....	115
To cotton seed meal and kainit plot .....	188
<hr/>	
<i>Average increase with acid phosphate</i> .....	97
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	265
To cotton seed meal plot .....	36
To acid phosphate plot .....	42
To cotton seed meal and acid phosphate plot .....	30
<hr/>	
<i>Average increase with kainit</i> .....	54

HENRY COUNTY, 3 1-2 MILES NORTH OF COLUMBIA.

THOS. Z. ATKESON, COLUMBIA, 1908.

*Light gray soil with yellow loamy subsoil.*

The field had been cleared about 40 years, the principal growth having been long leaf pine. There was very little rain from the time the seed were planted, and cotton wilt and root knot further reduced the yield under these unfavorable conditions. All fertilizers increased the yield, but none to any large extent.

Yet the increase on plot 5 was sufficient to pay a fair profit over the cost of the fertilizer.

	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	94
Increase of seed cotton when cotton seed was added:	
To unfertilized plot .....	785
To acid phosphate plot .....	96
To kainit plot .....	254
To acid phosphate and kainit plot .....	148
<i>Average increase with cotton seed meal</i> .....	144

Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot .....	35
To cotton seed meal plot .....	54
To kainit plot .....	74
To cotton seed meal and kainit .....	32
<i>Average increase with acid phosphate</i> .....	48

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot .....	33
To cotton seed meal plot .....	209
To acid phosphate plot .....	72
To cotton seed meal and acid phosphate plot .....	124
<i>Average increase with kainit</i> .....	109

*Fertilizer Experiments in Henry County.*

Plot No.	FERTILIZER		COLUMBIA		HEADLAND 1907		HEADLAND 1908	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	<i>Lbs.</i>		<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1	200	Cotton seed meal ...	173	78	392	80	1015	130
2	240	Acid phosphate ...	130	35	208	104	1130	245
3	....	No fertilizer.....	95	.....	312	.....	885	.....
4	200	Kainit .....	128	33	424	105	1020	150
5	200	Cotton seed meal ..	225	131	416	90	1245	390
	240	Acid phosphate ..						
6	200	Cotton seed meal ..	380	287	656	324	1130	290
	200	Kainit .....						
7	240	Acid phosphate ..	200	107	536	198	1170	345
	200	Kainit .....						
8	....	No fertilizer.....	93	.....	344	.....	810	.....
9	200	Cotton seed meal ..	3485	255	656	312	1425	615
	240	Acid phosphate ..						
10	200	Kainit .....	408	305	600	256	1410	600
	240	Cotton seed meal ..						
	100	Kainit .....						

HENRY COUNTY, 1 MILE EAST OF HEADLAND.

W. F. COVINGTON, 1907-8.

*Gray sandy soil with yellow loam subsoil.*

In 1907.—The experiment in 1907 was made on land that had been cleared about 40 years and was very poor, but otherwise representative.

The crop in 1906 was cotton fertilized with 500 to 600 pounds of a 9-3-3 guano. This probably explains in part why there was such poor response in 1907 to applications of phosphate. A further explanation is doubtless found in the observed fact that rust was worse on plot 2, fertilized with acid phosphate alone, than on other plots. Cotton seed meal and kainit both profitably increased the yield in whatever combination they were applied. The largest yield was made by a mixture of cotton seed meal and

kainit, on plot 6. Mr. Covington writes: "The kainit made good in every test, especially so on plots 4, 6, and 7. On these plots the leaves held longer and the bolls were larger and much better matured, this last being especially noticeable on plot 6."

In 1908, The field had been cleared about ten years. On this land, not so deficient in vegetable matter as that used the preceding year, a complete fertilizer gave the maximum yield and the maximum profit. Of the three constituents of the complete fertilizer, acid phosphate was most influential, closely followed by both of the others. It is notable that the complete fertilizer on plot 10, containing only 100 pounds of kainit, in addition to meal and phosphate, afforded almost as large a yield and a greater net profit than did the complete fertilizer on plot 9, which contained double this amount of kainit. The net profit due to 540 pounds of fertilizer on plot 10 was \$14.27 (600 lbs. at 3.2 cents, less \$4.93) per acre.

Apparently this soil needs a complete fertilizer and this conclusion is not shaken by the slight response to acid phosphate under the exceptional conditions of 1907, as stated above; this view is strengthened by the favorable results from complete fertilizers in earlier experiments on what seem to be similar soils in that part of the state.

	Lbs. Lbs.	
	1907.	1908.
<i>Average yield of seed cotton per acre, unfertilized</i> .....	328	848
Increase in seed cotton when cotton seed meal was added:		
To unfertilized plot .....	80	130
To acid phosphate plot .....	194	145
To kainit plot .....	219	140
To acid phosphate and kainit plot .....	114	270
<i>Average increase with cotton seed meal</i> .....	152	172

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .....	104	245
To cotton seed meal plot .....	10	260
To kainit plot .....	93	195
To cotton seed meal and kainit plot .....	12	325

*Average increase with acid phosphate* .....—3 256

Increase of seed cotton per acre when kainit was added:

To unfertilized plot .....	105	150
To cotton seed meal plot .....	244	160
To acid phosphate plot .....	302	100
To cotton seed meal and acid phosphate plot .....	222	225

*Average increase with kainit* .....218 159

### *Experiments at Betts, Conecuh County.*

Plot No.	FERTILIZER		BETTS 1905		BETTS 1906		BETTS 1907	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
1	Lbs. 200	Cotton seed meal...	Lbs. 784	Lbs. 216	Lbs. 1048	Lbs. 168	Lbs. 440	Lbs. 56
2	240	Acid phosphate ....	792	224	1064	184	424	40
3	....	No fertilizer.....	568	.....	880	.....	384	.....
4	200	Kainit .....	704	139	920	37	392	9
5	200	Cotton seed meal. }	864	302	1080	193	456	74
	240	Acid phosphate .. }						
6	200	Cotton seed meal. }	832	273	1056	166	456	76
	200	Kainit .....						
7	240	Acid phosphate .. }	824	269	1040	147	440	62
	200	Kainit .....						
8	....	No fertilizer.....	552	.....	896	.....	376	.....
	200	Cotton seed meal. }						
9	240	Acid phosphate .. }	896	344	1216	320	464	88
	200	Kainit .....						
10	200	Cotton seed meal. }	880	328	1200	304	456	80
	240	Acid phosphate .. }						
	100	Kainit .....						

## CONECUH COUNTY, 1-2 TO 1 1-2 MILES NORTH EAST OF BETTS.

R. H. BETTS, 1905-6-7.

*Gray sandy soil with red subsoil.*

The land on which these tests were made had been cleared for 30 or 40 years. The original growth was reported hardwood and short-leaf pine; if so, probably this soil is different from the average soil of the long-leaf pine belt.

In 1908 there was so much rain and such small yields that all fertilizers were about equally ineffective and unprofitable. In 1906 when both fertilized and unfertilized plots yielded well, complete fertilizer (on plots 9 and 10) afforded the largest net profit. In 1905 a mixture of cotton seed meal and acid phosphate was nearly as effective and quite as profitable as a complete fertilizer.

	1905	1906	1907
	Lbs.	Lbs.	Lbs.
<i>Average yield of seed cotton per acre, unfertilized</i>	560	888	380
<i>Average yield of seed cotton when cotton seed meal was added:</i>			
To unfertilized plot	216	168	56
To acid phosphate plot	78	9	34
To kainit plot	134	130	67
To acid phosphate and kainit plot	75	173	26
<i>Average increase with cotton seed meal</i>	126	120	46
<i>Increase of seed cotton per acre when acid phosphate was added:</i>			
To unfertilized plot	224	184	40
To cotton seed meal plot	86	25	18
To kainit plot	130	111	53
To cotton seed meal and kainit plot	71	154	12
<i>Average increase with acid phosphate</i>	127	119	31
<i>Increase of seed cotton per acre when kainit was added:</i>			
To unfertilized plot	139	36	9
To cotton seed meal plot	57	—2	20
To acid phosphate plot	45	—37	22
To cotton seed meal and acid phosphate plot	42	127	14
<i>Average increase with kainit</i>	71	31	16

**INCONCLUSIVE TESTS.**

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The following inconclusive experiments were made:

Bullock County, O. M. Hill, Suspension, 1906.

Bullock County, F. B. Haynes, 7 miles South of Union Springs, 1908.

Chambers County, E. W. Smart, Fredonia, 1905.

Fayette County, J. B. Gibson, Newtonville, 1908.

Pickens County, D. W. Davis, Gordo, 1906.

The yields in these tests are given in the next table.



*Inconclusive Experiments in Bullock, Chambers, Fayette, Montgomery and Pickens Counties.*

Plot No.	FERTILIZER	SUSPENSION 1906		UNION SPRINGS Haynes, '08		FREDONIA 1905		NEWTON- VILLE 1907		NEWTON- VILLE 1908		NAFTAL 1905		GORDO 1906	
		Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
				Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal . . .	808	16	450	150	816	728	650	336	72	608	72	880	256
2	240	Acid phosphate . . .	872	48	580	20	888	200	1080	408	144	488	48	752	128
3	200	No fertilizer . . .	824	600	600	688	440	640	264	19	536	187	624	29	
4	200	Kainit . . .	856	37	740	180	912	152	1200	280	19	688	187	608	29
5	200	Cotton seed meal . . .	1088	274	570	50	768	64	1320	272	14	336	130	688	38
6	200	Acid phosphate . . .	984	175	630	150	192	288	1080	412	23	560	129	936	273
7	240	Cotton seed meal . . .	1000	195	540	100	1376	400	980	230	44	656	260	672	174
8	200	Kainit . . .	800	400	400	1048	208	560	820	248	8	360	304	824	136
9	240	Acid phosphate . . .	960	160	450	50	1256	208	1380	256	16	712	352	848	160
10	240	Cotton seed meal . . .	1224	424	390	10	1096	48	1340	520	16	712	352	848	160
	100	Kainit . . .													



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**Agricultural Experiment Station**  
OF THE  
**Alabama Polytechnic Institute**  
AUBURN.

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**FACING THE BOLL WEEVIL PROBLEM  
IN ALABAMA**

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BY  
W. E.HINDS,  
Entomologist

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Opelika, Ala.:  
The Post Publishing Company,  
1909 .

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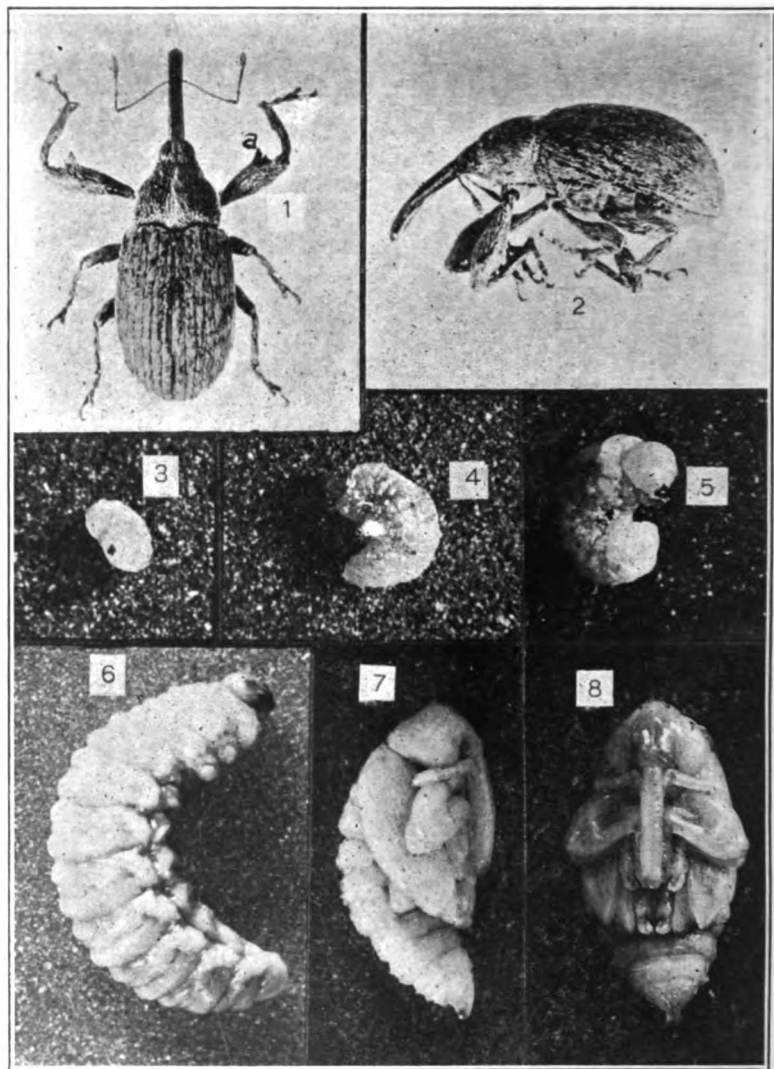
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# PLATE I.



## THE BOLL WEEVIL AND ITS STAGES.

Fig. 1, Adult boll weevil, viewed from above; *a*, two teeth on fore femur; fig. 2, adult weevil, side view; fig. 3, egg of weevil; fig. 4, grub about two days old; fig. 5, grub at entrance to second stage after shedding first skin, about three days old; fig. 6, grub fully grown, about ten days from egg; fig. 7, transformation or pupal stage, side view, snout, legs and wings forming; fig. 8, pupal stage, front view of fig. 7. Figs. 1, 2, 6, 7 and 8 enlarged about ten diameters; figs. 3, 4 and 5 enlarged about twenty diameters. (Original).

# FACING THE BOLL WEEVIL PROBLEM IN ALABAMA

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## INTRODUCTION.

That within three years the Mexican cotton boll weevil will have entered Alabama is as certain as it is that cotton will continue to be produced in this and adjoining states before that time. The certainty that the cotton planters of Alabama will soon have to contend with an enemy more difficult to fight and more destructive to the crop than anything which they have ever been forced to face should be a matter of deep and immediate interest to every citizen of the state regardless of his occupation. If we shall meet this grave problem in a manner to result in a minimum of loss to all branches of commercial and professional as well as of agricultural life, it is essential that we improve to the utmost the few years which may intervene in direct and united preparation for the great changes in agricultural practice and in economic conditions generally which the presence of this pest has invariably caused wherever it has gone. We may well be willing to profit by the experience for which our sister States of Texas, Louisiana and Mississippi, particularly have paid so large a price. We should by all means begin immediately to put into active operation some of the fundamental improvements in agricultural practice which have been worked out during the past few years as a direct result of the fight against the weevil. If these practices are advisable and profitable anywhere with the boll weevil present they may be made even more so here and now before the weevil arrives. The great opportunity for gaining experience and determining the immediate applicability of any of these practices to our local conditions is evidently the period before the weevil comes and while we do not have to suffer the losses which it is very certain to inflict wherever it exists.

It may be pardonable in this case to mention a few per-

sonal facts which may enable the reader to judge of the writer's competency in this subject. From July 1, 1902, until September 30, 1907, he was engaged constantly and exclusively under the U. S. Bureau of Entomology in the investigation of the Mexican cotton boll weevil in Texas. The seasons of 1902, 1903 and 1904 were spent principally in South Texas where the weevil had been abundant for several years and where it was doing great damage. The seasons of 1905, 1906 and 1907 were spent in north Texas, in a region which was then but recently infested. In this work he was associated with Mr. W. D. Hunter who has been in direct charge of the boll weevil investigation from 1901 to the present time. The most important of the boll weevil publications are referred to in the Bibliography, see page 100.

Within the limits of this brief paper it is impossible to touch upon many of the important and interesting points in the discovery, introduction, life history and control of this insect.

It spread into the Southern part of Texas from Mexico about 1892 and from that time to this nothing has occurred to more than temporarily check its annual advance into new cotton growing country. Its annual spread is mainly by flight and cannot be prevented by human effort. The best that can be done is to guard against assisting in the spread of the pest and to do everything possible to avoid and to minimize the injury which its very presence involves. As soon as the weevil entered Texas it became apparent that the investigation of methods for its control constituted a National, rather than a State problem. Since 1901 Congress has been making special appropriations for the investigation of the boll weevil and from one to twenty trained men have been giving their time constantly to the study of this most serious problem. The writer was personally engaged in this work for more than five years. Naturally the damage which it has done has increased from year to year with the increase in the area infested. It is safe to say that the loss which it now occasions cannot be less than \$25,000,000 each year.

The National government has spent more than \$1,000,000 in the investigations which have been made to discover effective methods of controlling the pest, and the various states affected have also expended large sums. The information and recommendations given in the following pages are gathered from the best that has been learned in this great struggle. A few of the important publications concerning the weevil are referred to in the Bibliography on page 100.

Since 1892 the weevil has spread Northward through Texas and the Southern half of Oklahoma and Eastward, crossing Louisiana, the Mississippi River and into Mississippi. From the infested territory each year it spreads ever onward as wave after wave spreads outward when a stone is cast into water. The old territory is not abandoned since only part of the host of weevils which is developed by fall will leave the field to seek new territory. Undoubtedly many fly back into previously infested fields where their presence is lost sight of but those which happen to fly in to new localities quickly establish a new line of infestation which can be quite readily marked.

The distance through which they have thus advanced has averaged fully fifty miles each year. The first weevils crossed the Mississippi River in the fall of 1907 and during the fall of 1908 eighteen counties in the western part of that State became either wholly or partially infested. The area now infested constitutes more than one third of the cotton growing area of the United States and produces nearly one-half of the annual crop. The limits of the infestation, the relationship which this bears to the entire commercial cotton growing area, and the annual progress of the pest during recent years are plainly shown upon the accompanying map, Fig. 1, which was prepared by Mr. W. D. Hunter during the fall of 1908 from data collected by the numerous field agents of the Bureau of Entomology investigating the spread of the boll weevil.



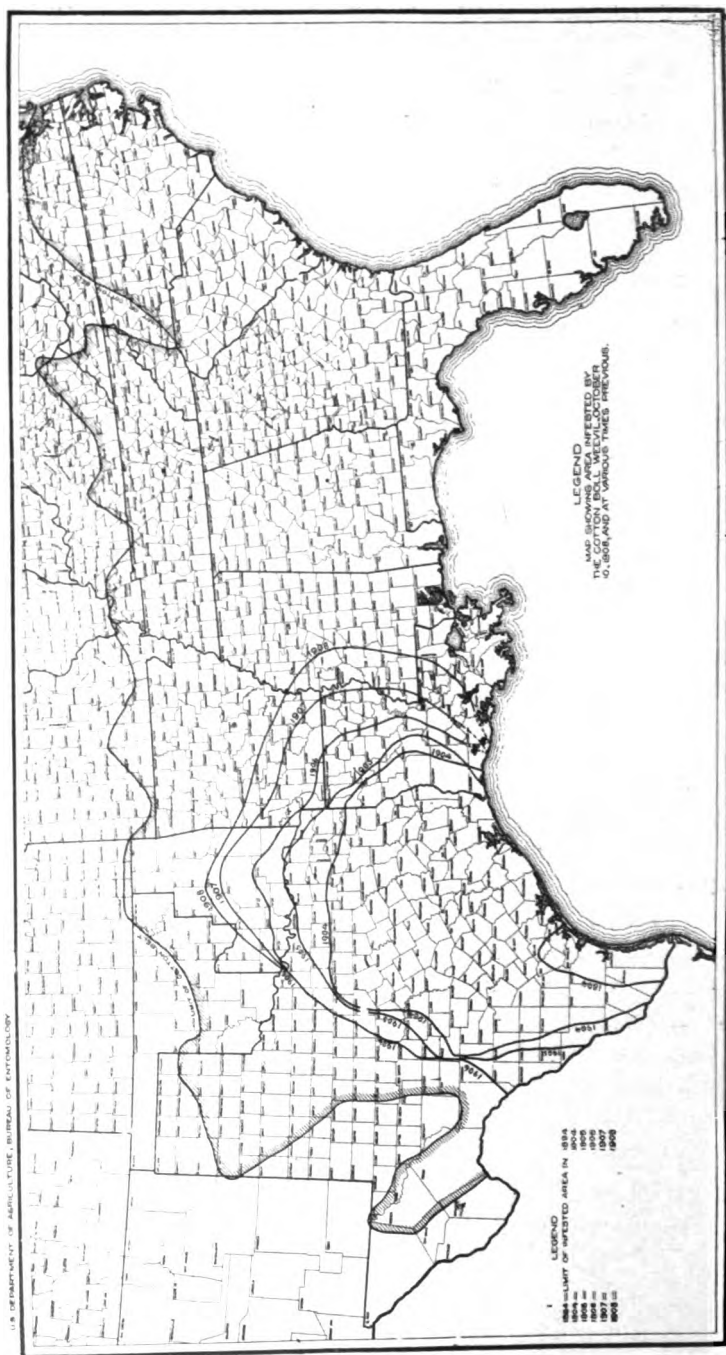


Fig. 1. The cotton growing area showing the area infested by the boll weevil during various years. (After Hunter, Farmers' Bul. 944.)

## WHEN WILL THE WEEVIL REACH ALABAMA?

A brief study of this map with the facts stated relating thereto should be enough to convince anyone that the advance of the boll weevil will most certainly continue. The present northern limit of infestation is farther North geographically than is any portion of Mississippi, Alabama, or Georgia. The existence of the boll weevil depends primarily upon the occurrence of cotton which is its only known food plant. Besides its dependence upon this food supply the continued existence of the weevil depends also upon its ability to survive the winter climatic conditions in order to pass from the crop of one season to that of the next. The weevil has already shown that it can withstand successfully temperatures reaching nearly if not quite to Zero F. which is as low as is likely to occur anywhere in the cotton belt.

The eastward spread of the weevil therefore promises to be as certain and as rapid as was its northward spread through Texas and Oklahoma until ultimately it shall infest cotton wherever grown commercially in the Southeastern States. Its spread may be accomplished in two general ways.

In the first place the weevil will continue to spread by its own unaided flight which man is powerless to prevent. The entire area embraced within a line passing through the outermost points thus reached each year must be considered as constituting the "area of general infestation" although the weevil may not occur at many of the places included within but near the outermost edge of this area. The line referred to is "the line of general infestation" and this is what we reckon with in the annual spread of the boll weevil. It may be shown that this line has been steadily advanced through an average distance of about fifty miles each year. We may expect this rate to be maintained as the weevil continues eastward to the Atlantic Coast. From this basis we may easily and quite certainly determine that in two seasons more, that is by November 1910, we may expect the line of general infestation to reach the Mississippi-Alabama boundary. It is quite likely that some of the western tier of

counties in this State may then become partially infested. It will require only about three years more for the weevil to spread over the entire State and to reach Western Georgia. Therefore we may consider it practically certain that throughout the western third of Alabama by the summer of 1911, through the central third by 1912, and through the eastern third by 1913, and in each case constantly after those dates, every cotton planter will have to reckon with the presence of the boll weevil and some degree of injury by it.

In the second place, we must consider that the boll weevil is *liable* to be brought into the State at any time ahead of the general infestation by the various methods of transportation, principally by railroads, with persons, household goods, cotton and its products, or with any other articles which may contain or shelter them. This danger naturally increases as the line of infestation approaches more closely. In numerous instances in Texas, Louisiana, Mississippi and elsewhere it has been clearly established that the weevil has been carried long distances in shipments of cotton seed from infested areas although fortunately it has not yet happened in the direction of uninfested territory. Infested cotton produced in the edge of the infested area has been hauled considerable distances beyond for ginning and planters bringing their cotton from other directions have carried away weevil-infested seed with them. Tenants and cotton pickers moving from infested to uninfested territory are very liable to carry weevils with them and thus establish new centers of infestation. These are among the considerations which have made necessary the establishment and strict enforcement of quarantine measures to guard against the accidental introduction of the weevil.

#### QUARANTINE REGULATIONS AGAINST THE BOLL WEEVIL.

Alabama passed such a law in 1903, and placed the enforcement of the act in the hands of the State Board of Horticulture, as at that time there was no special Ento-

mologist connected with the State Experiment Station.

#### TEXT OF ALABAMA BOLL WEEVIL LAW.

AN ACT to prevent and prohibit the importation of seed from cotton affected with the Texas boll weevil.

SECTION 1. Be it enacted by the legislature of Alabama, That no person shall import or bring into the State of Alabama any seed from cotton affected with what is known as the Texas boll weevil, nor the seed from any cotton from any place where the cotton has been affected with said boll weevil.

SEC. 2. Any person who violates the provisions of section 1 of this Act shall be guilty of a misdemeanor, and on conviction shall be fined not less than ten dollars (\$10.00) and not more than five hundred dollars (\$500.00).

(H. 877, No. 559, approved Oct. 6, 1903.)

In addition to the above, the State Board of Horticulture organized by Act of the Legislature No. 121, approved March 5, 1903, has established regulations governing the shipment into and through the State of cotton products, packing materials, household goods, etc. The text of the regulations which are at present in force is as follows:

#### RULES AND REGULATIONS

##### GOVERNING THE IMPORTATION OF ARTICLES LIABLE TO CONTAIN THE MEXICAN COTTON BOLL WEEVIL.

RULE 11. In accordance with an act of the Legislature of the State of Alabama entitled: An act to Further Protect Horticulture, Fruit Growing and Truck Gardening, and to Exclude Crop Pests of all kinds in the State of Alabama, approved March 5, 1903; the following rules and regulations relative to the Mexican Cotton Boll Weevil were adopted:

(a) That in order to prevent the introduction of the Mexican Cotton Boll Weevil into the State of Alabama, a rigid quarantine is hereby declared against all infested localities in Texas or Louisiana, and of other sections that are or may hereafter become infested.

(b) That cotton lint (loose, baled flat or compressed) cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks (which have been used) and corn in the shuck, originating in cotton boll weevil infested localities, shall be excluded absolutely from the State of Alabama.

(c) All shipments of household goods from infested areas shall be prohibited unless the same is accompanied by an affidavit, attached to the way-bill stating that the shipment contains no cotton

lint, cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks or corn in the shuck.

(d) All shipments of quarantined articles, mentioned in section (b) above, through the State of Alabama shall be made in tight, closed cars.

(e) No common carrier shall use for bedding, or feed for live stock, any of the quarantined articles when the shipments originate in regions infested with the cotton boll weevil.

(f) All railroads, steamboats, express companies and other common carriers, and all private vehicles, boats, etc., entering the State of Alabama from the states of Texas or Louisiana, or passing through the State of Alabama from any of the infested districts of the States of Texas or Louisiana, are especially enjoined to comply with the requirements of this order and of laws of the State of Alabama governing the same.

**RULE 12.** The State Horticulturist is hereby charged with the enforcement of the rules and regulations relative to the Mexican boll weevil.

The form of affidavit accompanying the waybill with shipments of household goods should specify the prohibited articles as not included, as follows:

State of....., County of .....  
 Before me .....Notary Public in and  
 for said State and County, personally appeared .....  
 ..... who being duly sworn states on oath that the  
 shipment of ..... waybill of which this affidavit ac-  
 companies, does not contain any cotton lint, cotton seed, hulls, seed  
 cotton and cotton seed sacks or corn in shuck.  
 Sworn to and subscribed before me this.....day of .....  
 190..

(Seal) ..... Notary Public.

At the bottom of all law lies the general consideration that the safety and welfare of the public is more important than the convenience or interest of any private individual. It is certainly of public advantage that every possible precaution be taken to prevent needlessly hastening the spread of so dangerous an insect pest as this. The advance of the weevil will gradually transfer states, counties, and localities from the uninfested to the infested territory and thus reduce the area in which quarantine measures apply. Within five years, therefore, the boll weevil quarantine may become a thing of the past in this State. In the meantime it

is of highest importance that we be able to definitely establish the limits of infestation and determine just where the application of the quarantine will do good instead of harm. Obviously no restriction of personal or commercial movement is justifiable or desirable if no protection or benefit may result. We therefore urge upon all concerns or individuals to whom the provisions of this quarantine may apply that they continue to give it their cheerful and complete support so long as may be necessary. More detailed information will be furnished all who may request it upon any specific points by the "Entomologist to the Experiment Station, Auburn, Ala."

#### DESCRIPTION OF THE BOLL WEEVIL.

It is of extreme importance that we learn of the presence of the weevil anywhere in the state as quickly as possible after its arrival. For information on this point we must necessarily depend principally upon the reports of cotton planters and others directly interested in this subject. As a rule we cannot depend for this information upon newspaper reports, even when these are vouched for by some planter who "came from the boll weevil country". With the boll weevil, as with most other insects, the ordinary casual observer fails to notice any but the most obvious characters on account of their small size. Therefore the characters noted are more than likely to be only those which are common to a group including hundreds of closely related species rather than those distinctive of a single species. By careful attention to the following brief description and to the illustrations given herewith we believe that the reader of average intelligence may be able to distinguish the boll weevil from the numerous other insects occurring on cotton, which are often mistaken for it (see appendix) and to recognize its attack on the plant with a reasonable degree of certainty. In any case of doubt specimens should be sent immediately in a strong, tight, tin or wooden box, with a letter of explanation to the Entomologist, Alabama Experiment Station, Auburn, Ala. He will gladly determine

such specimens and report to the sender entirely free of cost.

The boll weevil is a beetle belonging to a large group, all of which are characterized by having part of the head in front of the eyes greatly extended to form a long slender snout. There are many hundreds of species of these insects, all of which are commonly called "weevils", but the Mexican cotton boll weevil is the only one of these many species which is at all serious as an enemy of cotton. While other species may be found upon cotton plants, their occurrence there is mainly accidental. Rarely indeed does any other species breed upon cotton. The boll weevil breeds upon cotton and upon nothing else. Like all other beetles the boll weevil has four distinct stages in the development of each individual. These are the egg (Pl. I, fig. 3), which is only about 1-30 of an inch long, white and delicate. This is always deposited in a cavity which the female eats in the square or boll and upon no other part of the plant. From the egg there hatches in a few days a white, legless grub or worm (Pl. I, figs. 3-6) which does not at all resemble the beetle which it may finally become. The grub of the boll weevil resembles very closely that of the "plum curculio" which is so familiar a pest in peaches, plums, cherries, etc., working in the fruit and usually around the stone. The boll weevil grub grows steadily from its initial length of about 1-25 of an inch until it becomes fully grown and measures from 1-5 to 2-5 of an inch in length. The body is strongly curved in the form of a crescent, in this respect being more curved than the "worm" in peaches, etc. (Pl. I, fig. 6.)

In order to attain the beetle form the grub must pass through an intermediate "transformation stage" which is known as the "pupa." (Pl. I, figs. 7 and 8.) \* In this stage no food is taken, and there is a complete change of the appearance and of structure. The grub sheds its skin and instead of the legless, wingless, snoutless worm, the pupa appears with all of these organs forming in sheaths closely applied to the body. In this stage the insect is very delicate,

and perfectly helpless. It, as well as the egg and grub stages, is passed wholly within the interior of the square or boll. These three constitute the immature stages in the life of the weevil, but are as characteristic of the insect as is the adult form.

After a few days the pupa sheds its skin and becomes the fully formed adult weevil as shown in Pl. I, figs. 1 and 2, having the legs and snout free and usable, as are also the wings, which are folded back, under and protected and hidden by, the hard wing-covers, which meet in a straight line over the middle of the back of the beetle. For a few days the adult also remains protected within the square or boll while it becomes hardened and more able to care for itself. It then cuts a circular hole just the size of its body in the wall of its cell in the square, and through this opening makes its escape into the outer world, where from that time on it leads a free and active life.

The adult weevil, therefore, is the form most commonly seen around infested cotton, and this stage needs a more detailed description. The full grown weevils vary considerably in size and in color. In length they range between 1-8 and 3-8 of an inch, while the breadth of the body is approximately 1-3 of its length. The general color is uniform over the body and varies from a chocolate brown in the darkest specimens, which are usually below average size, to a grayish or yellowish brown in the lighter colored larger forms. The lighter colors are due to light colored scales or modified hairs which occur most abundantly in the larger specimens. If these are undeveloped or become rubbed off, then the dark brown ground color of the weevil appears. The slender snout is only slightly curved and is about 1-2 as long as the length from the head to the tip of the body. Neither the size, nor the structure or general appearance of the weevil changes at all after its emergence from the square or boll in its adult form. The adults feed and mate and the females then deposit eggs. This completes the "Life Cycle" and starts another generation all within a period of from three to four weeks.



## THE EFFECT OF WEEVIL WORK ON COTTON.

The recognition of the presence of the boll weevil may depend upon the identification of the adults or the immature stages in squares and bolls or just as certainly upon the recognition of its feeding injuries or the effect of its work upon the fruiting of the cotton, as these are also characteristic. No other insect produces at all similar injuries to cotton.

The excrement deposited by the adult weevils on the squares upon which they work is of a bright orange color and so forms a conspicuous sign of boll weevil presence. The egg punctures, like those made for feeding, are eaten out but are only made large enough to receive the egg which is placed just inside of the floral coverings and usually near the base of the bud. The natural tendency of the green parts of plants to heal wounds in which decay does not occur causes a growth of plant cells to more than fill the canal leading to the egg cavity. The excess of this growth bulges outward so that it forms a distinct "wart". This "wart" is therefore characteristic of a boll weevil egg puncture. As the grub feeds and grows inside the bud it destroys the very heart of the square, until when about half grown its injury thereto becomes so great as to cause the destruction of that bud. The leaflets enclosing the bud spread apart, or "flare" as it is called, and the whole square turns yellow, wilts and is shed as are leaves when they can be of no further use to the plant. It is Nature's surgery in removing a diseased and useless member. Upon the ground the development of the grub continues and its transformation through the pupal stage to the adult beetle takes place. Practically one-half of the developmental period is spent in the square on the plant and the other half in the square after it has fallen to the ground. Badly infested cotton produces few, if any, blooms, while the infested squares shed by the plant as fast as they form are thickly scattered beneath it on the ground. Squares may be shed as a result of adverse cultural or climatic influences, but

when shed from such causes they show no signs of weevil or other insect injury such as have been described.

### RECOGNITION OF THE WEEVIL.

We may summarize briefly the most important characteristics upon which we may depend for the prompt recognition of the weevils' presence in Alabama:

1. The adult beetles (Pl. I, figs. 1 and 2) probably found on cotton only, are about 1-4 inch long, with slender, slightly curved snouts, of dark brown, ashy-gray, or yellowish brown color.

2. The crescentic grubs (Pl. I, fig. 6) about 3-8 inch long and the pupal stages (Pl. I, figs. 7 and 8) occur only in squares and in bolls. This is the only insect which breeds in this way in cotton.

3. The occurrence of open cavities 1-16 to 1-20 inch in diameter and reaching down to larger excavations among the pollen sacs, the presence of "warts" marking the egg punctures of the weevil, the occurrence of the orange-colored excrement on the buds, the abundant shedding of squares and the consequent scarcity of blooms without accompanying rain or cultural conditions to cause the shedding; these are among the most conspicuous signs of boll weevil presence and injury.

**Whenever any specimens of weevil or cotton squares or bolls showing weevil stages or the signs of their work are discovered anywhere in Alabama in advance of the general infestation by the weevil, it is of the utmost importance that they be immediately submitted to the Entomologist, Auburn, for positive identification. We must depend upon the hearty co-operation of cotton planters in this work, as upon the promptness with which the first occurrence of the weevil in a locality is discovered and reported to the Entomologist**

depends entirely the possibility or advisability of undertaking any measures for the extermination of the weevil which might prevent the infliction of damage to that locality for several years before it would necessarily occur through coming within the area of general infestation.

Undoubtedly during the next few years local newspapers, as well as the leading papers of the State, will frequently receive reports of the occurrence of the boll weevil in their vicinity. Editors, before publishing such items, should secure specimens and forward them to the Entomologist and await his report as to their genuineness. Published statements, if untrue, can only do harm among their readers, and for a time the harm will be as great as though they were true, as they will affect all agricultural and business interests. This is too serious a matter to permit of the creation of undue excitement through the circulation of misleading impressions. The situation should be faced calmly, intelligently and courageously to safeguard the best interests of all who may be affected by whatever effects the production and sale of cotton. If faced in this spirit there is absolutely no need for the existence in Alabama of the feeling of "panic" which has heretofore accompanied the weevil during the first few years of its occupation of new territory.

## HOW THE BOLL WEEVIL MAY BE SUCCESSFULLY CONTROLLED.

The great difficulty in fighting the boll weevil has arisen from the fact that the peculiar habits of the adult and the protection of the immature stages within the squares and bolls render it practically useless to attempt to destroy them by any usual methods of insecticidal treatment. Hundreds of remedies have been tested and found ineffective for the above reasons, if for no others. As in human warfare, one of the most effective measures of subduing an enemy consists in destroying their food supplies, so it is equally true in the case of an insect which is dependent upon one species of food plant as is the boll weevil. That the weevil can be effectively controlled and the culture of cotton continued at fully as great profit as has usually been realized without the weevil, has been proven possible through the practical application in many thousands of cases in the weevil area of improved methods in cotton culture and in general agricultural practice. Some of these measures take advantage of and increase the effectiveness of certain factors of natural control. Most of them, however, are merely **steps in a system of cotton culture** which prepare the way for the application of the **one most effective direct method of destroying immense numbers of weevils by cutting off their food supply at the only season of the year when the destruction of cotton is possible, practicable and most effective in reducing the number of weevils.** The final step is the complete destruction of all green cotton at least three or four weeks before the usual date for the occurrence of the **first killing frost in the fall.** This has often been called the most important single step in the cultural system of controlling the boll weevil. It may seem to many that it cannot be successfully applied under the conditions existing in Alabama. That has been claimed

also in Texas, Louisiana and elsewhere, but it has been found always that **it is possible under almost all conditions if the necessary steps leading up to it are also employed.**

We must remember that the presence of the boll weevil inevitably produces a change in the conditions of cotton growth. Practically, there can never be "late cotton" in the infested area. The only portion of the crop to escape the weevils and mature is that which develops early in the season before the weevils have reached their maximum abundance. Therefore the very presence of the weevil tends to limit cotton production to the early crop and to clear the way for the proposed and necessary destruction of the stalks.

The effectiveness of this practice has been most positively established by the repeated experience of planters on large as well as upon small scales, and also through Nature's object lessons whenever through the effects of unusual climatic conditions or when by the defoliation of the plants by the cotton leaf caterpillar or cotton worm there has resulted the practically complete destruction of cotton at an unusually early date in the fall. In every such case the fall destruction has been followed by larger crops, less weevil injury and a great increase of net profit in the crop of the following year.

We have not room in this paper to give details regarding any of these great demonstrations, but can merely state that in many cases where the work has been conducted most carefully with adequate checks **the value of the increase in the crop on the area where stalks were destroyed has been from \$15.00 to \$20.00 per acre, as compared with the yield on the check areas on which the stalks were allowed to stand until the usual time of preparation for planting in the spring. In all other respects both areas received similar treatment and were grown under like conditions.**

## STEPS IN THE CULTURE OF COTTON FOR CONTROLLING THE BOLL WEEVIL.

The immediate adoption of such improved agricultural practices, as rotation and diversification of crops, better culture and more careful selection of seed for cotton **as soon as the weevil is known to be within less than 100 miles of any locality.**

In order to practice early destruction of stalks it is essential that part, at least, of the other steps be also adopted as they are of prime importance in leading up to the early maturity of the crop. It is impossible for us here to attempt to describe these steps at all fully. Much more can be learned regarding them from a study of the publications referred to in the brief Bibliography on page 100.

If we begin this work for the control of the weevil in the fall, as is desirable for securing its greatest effectiveness, it may involve the sacrifice of a small amount of cotton from the late maturing bolls. It is not necessary to make this sacrifice until the first year that the weevil is likely to reach the locality. After that time the possible loss of a few pounds of "scrappings" should not be allowed to count as against the necessity for and larger benefits of early destruction.

**DESTRUCTION OF STALKS.**—The best method of destroying the stalks is by uprooting and burning them. The roots, if cut, should be cut below the surface to prevent their putting out sprouts later. The plants should be thrown into windrows or piles while still green so that the leaves, squares and bolls may not be scattered but will remain on to assist in the early burning of the stalks and also because it is desired to destroy immediately the immature stages which may be present. Sometimes it will be found worth while to apply crude oil to facilitate the burning before the stalks have time to fully dry.

**ADVANTAGES OF EARLY BURNING.**—1. It stops absolutely the development of weevils late in the fall by destroying the immature stages then present in squares and bolls. 2. By

the complete removal of their only food it forces the dispersion and starvation of the weevils already adult. Obviously the longer the period between the destruction of all green cotton and the occurrence of the first killing frosts, at which time the weevils may go into winter quarters with most assurance of survival, the more complete will be the destruction of the adults. 3. It removes a large amount of rubbish within which those weevils which escape destruction would find the most favorable conditions for their successful hibernation. 4. It prevents the development of adults emerging shortly before frost. These are the weevils which ordinarily stand the best chance of living through the winter. Where one weevil may live through the winter if stalks are destroyed by the 15th to the 20th of October, there will be at least ten survivors if the destruction of stalks is delayed until the middle of November. There is a constant increase in the percentage of survival between these dates.

**PREPARATION OF THE LAND FOR COTTON.**—This should be more thorough than is usually given. On light soils fertilizers are needed for cotton, and those containing a relatively large percentage of phosphoric acid tend to promote the early maturity of the crop.

**PLANTING.**—Let this be done as soon as danger of frosts is passed. Early planted cotton invariably does better than even medium planted where the weevil occurs. It is desirable that the planting in a locality should be done as near the same date as possible, so that all of the cotton will be coming on together. The weevils thus have no chance to get a start upon any of the fields. Plant the rows at such distance apart as has been found to give best yields in any field.

**CHOPPING.**—Chop to a stand early, as this gives the plants that are left a better start. Space the plants as has been found best for yield in any field.

**CULTIVATION.**—This should be frequent and shallow. Its first object is to keep the soil in favorable condition for producing a steady and rapid growth of the crop. The destruction of weeds is accomplished incidentally. The surface

crust that may form after rains should be broken up as soon as possible.

**HARVESTING.**—Let this be done as quickly as the bulk of the crop is open. Every effort should be made to have ready the necessary labor supply for this work as soon as it may be done. Remember always the need for keeping a winter cover crop on the soil and for clearing the way for the early destruction of the stalks. The earlier these may be destroyed the better. **Their destruction constitutes the last step in dealing with the cotton crop each year where the boll weevil is present and is also the first step in preparation for the next crop of cotton, even though the cotton may occupy some other field through the system of rotation.**

#### CONCLUSION.

We hope that we have made plain that the coming of the boll weevil is assured, and that we shall very soon have to reckon with it constantly in the culture of cotton. We hope also that what we have said may help the cotton planters of the State to face this serious question more intelligently and more courageously than they would otherwise have done. In spite of the admittedly serious nature of the weevil as an enemy of cotton, there is no need for a "feeling of panic" if the recommendations given herewith are put into practice immediately. Their general application will improve the conditions of farm life, increase the value of farm property and multiply profits to both owners and tenants. In most sections where the weevil has already gone there have been heavy losses during the first two or three years of infestation because planters have been slow in adopting just the changes in cotton culture which have been outlined herein. They have thought at first that they were perfectly familiar with the best methods of raising cotton, and that no "scientists" could tell them anything about it. As a result, they have been finally forced to give up cotton altogether, or to adopt part, at least, of the methods which



have been described. With the adoption of the improved practices the control of the boll weevil has ceased to be an exceptionally serious problem, and they have found that in this way it is entirely possible to raise as much, or even more, cotton per acre as they were accustomed to raise before the coming of the weevil. The diversifying of crops has helped to make the farmers of the boll weevil area more independent of cotton as a single crop, and in many sections they are now more prosperous than ever before. In many respects the advent of this pest has resulted in greater final benefits than its injuries, and there has been brought about within five years a greater agricultural development than would have been likely to have come in two or more times as long but for the coming of the weevil.

**If it shall lead to the immediate application of many of the improvements herein recommended, then the coming of the boll weevil shall bring a blessing and not a curse to this State. May every agency be united in a helpful co-operative campaign of progressive education that shall prepare us to best meet and to most effectively overcome the boll weevil in Alabama.**

#### BIBLIOGRAPHY.

This is intended to be only a very partial list of the publications relating to the boll weevil, but to include those available which may be most useful to the planters of Alabama.

Publications of United States Department of Agriculture, Bureau of Entomology, Washington, D. C.

Bulletin No. 51. The Mexican Cotton Boll Weevil. Hunter & Hinds. 181 pp. Published 1905. (Write your Congressman for a free copy.)

Bulletin No. 74. Some Factors in the Natural Control of the Mexican Cotton Boll Weevil. Hinds. 79 pp. Published 1907.

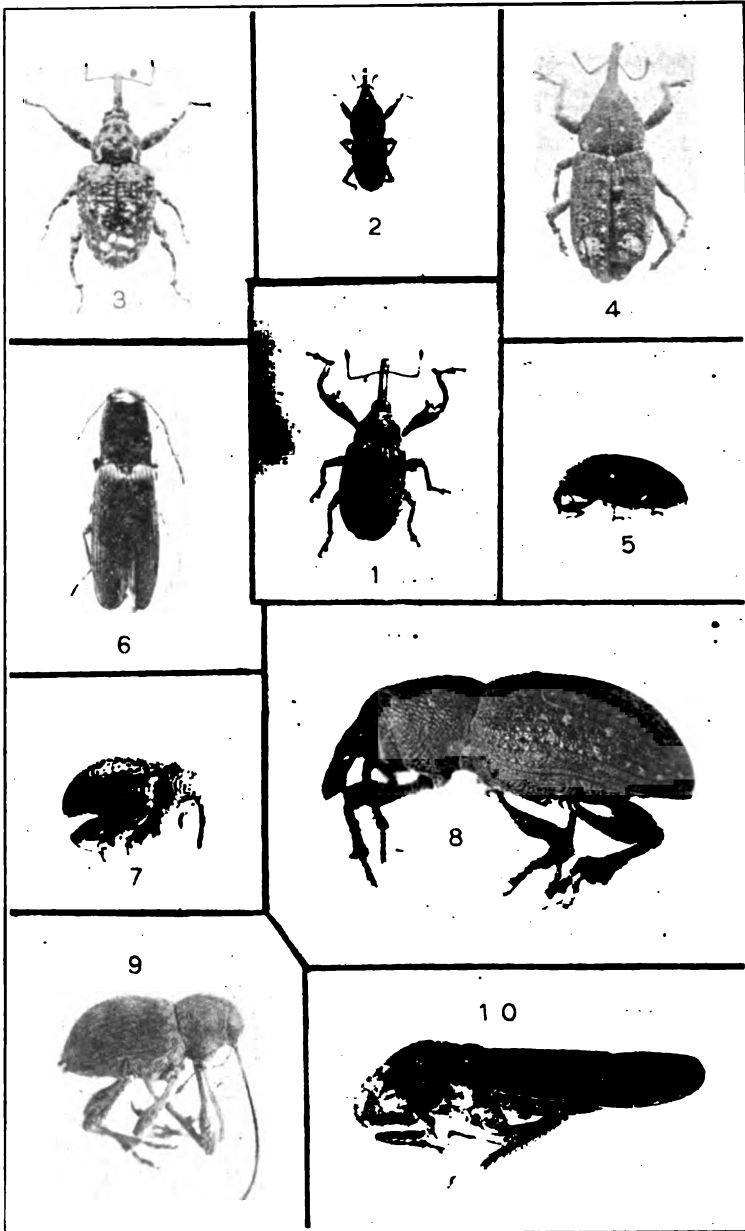
Farmers' Bulletins Nos. 47, 130, 163, 189, 209, 211, 216, 217, 223, and 344.

(All of the above relate to cotton insects, the boll weevil or to cotton culture, and may be obtained free upon request to the Department.)

Publications of Louisiana Crop Pest Commission, Baton Rouge, La. Circulars 8 and 23.



# PLATE II.



## INSECTS OFTEN MISTAKEN FOR THE BOLL WEEVIL.

Fig. 1, Boll weevil (*Anthonomus grandis* Boh.); fig. 2, rice weevil which breeds abundantly in corn (*Calandra oryzae* Linn.); fig. 3, plum curculio (*Conotrachelus nenuphar* Hbst.); fig. 4, white pine weevil (*Pissodes strobi* Peck.); fig. 5, transverse Baris (*Baris transversa* Say); fig. 6, a click beetle (*Monocrepidius vespertinus* Fab.); fig. 7, cow pea pod weevil (*Chalcodermus aeneus* Boh.); fig. 8, Pales weevil (*Hyllobius pales* Hbst.); fig. 9, an acorn weevil (*Balaninus* sp.); fig. 10, sharpshooter (*Homalodisca triquetra* Fab.). All enlarged about five diameters. (Original.)

## APPENDIX

### The Mexican Cotton Boll Weevil and Some of the Insects Most Frequently Mistaken for it.

For the sake of facilitating comparisons a figure of the boll weevil is included on Plate II. Fig. 1. All figures have been taken at the same magnification of approximately four diameters.

In this list the "rice weevil," (*Calandra oryzae* Linn), Pl. II, fig. 2, has been included not so much because it has been, or may be, mistaken for the boll weevil, as because its size and general appearance may be more familiar to the general reader than any of the other species mentioned. A comparison of the adult insect with the illustration may aid in conveying a more correct conception of the other less familiar species. This weevil breeds very abundantly in corn, but does not injure cotton.

The "plum curculio", (*Conotrachelus nenuphar* Hbst.), Pl. II, fig. 3, which attacks peaches, plums, etc., very commonly, is about the size of the boll weevil but is much darker in color with markings of white or light colored scales on its back and legs. It has a shorter, more strongly curved snout and but a single tooth upon the thigh of the fore legs. It never attacks cotton.

The "white pine weevil", (*Pissodes strobi* Peck.), Pl. II, fig. 4, occurs in Alabama and must attack also some southern species of pine. The body is longer and more cylindrical, while the snout is relatively much shorter than in the boll weevil. Its wing-covers bear each a prominent white spot toward their tips.

The "pales weevil", (*Hylobius pales* Hbst.) Pl. II, fig. 8, is another species which attacks pine. It is a large species, being from 1-3 to 1-2 inch long. Its color is a dark brown with small spots of light colored scales scattered over the wing-covers. This species is very common in Alabama.

The "cow-pea pod weevil", (*Chalcodermus aeneus* Boh.), Pl. II, fig. 7, is often taken on cotton following a crop of cow peas in the same field or near vicinity. It is the only one of the species mentioned herewith which may do some

slight damage to cotton. It sometimes feeds on the young cotton plants, boring into the main stems or leaf stems and causing the death of leaves and tips, but there is only one record of its having bred in a cotton square. The adults are shining black in color, somewhat shorter and more stoutly built than is the boll weevil, and the back of the body shows numerous small, circular pits arranged in several rows along the wing-covers.

The "transverse Baris", (*Baris transversa* Say), Pl. II, fig. 5, is a small, black weevil much shorter, broader proportionately and flatter than the boll weevil. Its snout is very short and strongly curved. This species breeds in the roots of cocklebur, and the adults occur accidentally upon cotton as may another closely related and similar appearing species that breeds in the roots of ragweed.

There are several species of "acorn weevils" belonging to the genus *Balaninus*. One of these is shown in Pl. II, fig. 9. All have very long, slender snouts, sometimes even longer than the body. All breed in acorns, and are often attracted to lights, as the boll weevil never is.

Some of the "click beetles" have a habit of hiding during the day in cotton squares, and are therefore mistaken for the boll weevil, although they do not resemble it in the least. One of these (*Monocrepidius vespertinus*, Fab.), Pl. II, fig. 6, is most commonly mistaken. In its early stages it lives on the roots of grasses in the cotton field, and the adult hides around the plant, but it does not attack cotton at all. These are all long, slender, flat-bodied beetles which, if turned over on their backs, will spring into the air with a "click" and thus regain their footing.

The last species that we have space to mention here is a bug belonging to a group of insects known as "leaf hoppers". These insects have the habit of sucking sap from the stems of plants and may occur on cotton where they have sometimes been called "sharp-shooters". These are grotesque insects which do not resemble the boll weevil at all. One species, (*Homoladisca triquetra* Fab.), is shown in Pl. II, fig. 10.





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